

Reviewed: New Surface Pro 4 is faster & better than before

PCWorld

NOVEMBER 2015



Meet the Surface Book

Microsoft's stunning Windows 10 laptop



ScanSnap

Book smart

SV600 contactless scanner

Floating optical array

Curvature correction

Page turn detection



<http://ez.com/pcwo>

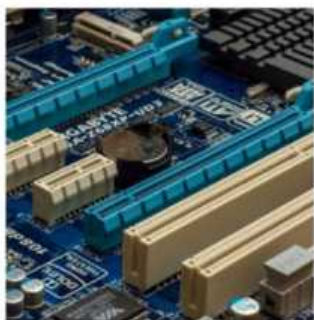


© 2015 Fujitsu Computer Products of America, Inc. All rights reserved. Fujitsu and the Fujitsu logo are registered trademarks of Fujitsu Ltd. All other trademarks are the property of their respective owners.

» DEPARTMENTS



73 Reviews & Ratings



119 Here's How



51 Consumer Watch

» NEWS



8 Microsoft's 7 biggest new hardware reveals



15 Hands on: Microsoft's Surface Book is a stunner



» COLUMNS

142 Hassle-Free PC

145 Answer Line

149 Tech Spotlight

PCWorld

CCO & SVP, U.S. MEDIA AT IDG John Gallant
EDITOR IN CHIEF, CONSUMER BRANDS Jon Phillips
DESIGN DIRECTOR Rob Schultz

EDITORIAL

EXECUTIVE EDITORS Melissa Riofrio, Gordon Mah Ung
SENIOR EDITORS Michael Brown, Brad Chacos, Mark Hachman
ASSOCIATE EDITOR Caitlin McGarry
STAFF WRITER Florence Ion
COPY EDITOR Sue Voelkel

DESIGN

DESIGNER Monica Lee

ADVERTISING SALES

SALES MANAGER Duane Hampson (415/978-3133)

PRODUCTION

DIRECTOR, PRODUCTION Nancy Jonathans
SENIOR PRODUCTION MANAGER Tamara Gargus

FOUNDERS

FOUNDER David Bunnell
FOUNDING EDITOR Andrew Fluegelman

INTERNATIONAL DATA GROUP, INC.

CHAIRMAN OF THE BOARD Walter Boyd
CEO, IDG COMMUNICATIONS Michael Friedenberg

REPRINTS AND PERMISSIONS

You must have permission before reproducing any material from *PCWorld*. Send email requests to permissions@pcworld.com; please include a phone number in your message.

BACK ISSUES

PCWorld back issues can be downloaded in digital format from www.zinio.com at \$6.99 per issue. Back issues in print format (subject to availability) cost \$8 per issue for U.S. delivery, and \$12 for international delivery; prepayment in U.S. currency to *PCWorld* is required. Send a check or money order to *PCWorld* Back Issues, P.O. Box 37881, Boone, IA 50037-0781.

SUBSCRIPTION SERVICES

Access your subscription account online—24 hours a day, 7 days a week. You can use online subscription services to view your account status, change your address, pay your bill, renew your subscription, get the answers to frequently asked questions, and more.

WEB pcworld.com/support

EMAIL maghelp@pcworld.com

(Send your full name and the address at which you subscribe; do not send attachments.)

PHONE In the U.S. and Canada: 800/234-3498

QUESTIONS AND COLUMNS

Send material electronically to the appropriate online address listed below, or mail it to *PCWorld*. We reserve the right to edit letters.

ANSWER LINE answer@pcworld.com

MAILING LISTS

Occasionally we make our magazine subscribers' names available to other firms whose products may interest you. To have your name excluded from these mailings, send a request and your email address to PCWorld Subscriber Services at maghelp@pcworld.com.

CONTACT

PHONE 415/243-0500; **FAX** 415/442-1891

MAIL Editorial: 501 Second Street #600, San Francisco, CA 94107

STAFF ADDRESS To contact any *PCWorld* staff member, simply format the address as follows: firstinitiallastname@idgcsmb.com

PUBLICATION INFORMATION

Volume 33, number 11 *PCWorld*™ (ISSN 0737-8939) is published monthly at \$24.95 for one year (12 issues) by IDG Consumer & SMB, Inc. Copyright 2015, IDG Consumer & SMB, Inc. All rights reserved. *PC World* and Consumer Watch are registered trademarks of International Data Group, Inc., and used under license by IDG Consumer & SMB, Inc. Published in the United States.

I was one of the **1** in **5**
Children in America who
STRUGGLE WITH HUNGER
join me and help put an
End to childhood hunger.

Viola Davis



**HUNGER IS
ALL OF US**

HELP UNDO CHILDHOOD HUNGER. GO TO HUNGERIS.ORG

THE
SAFeway
FOUNDATION

The *Hunger Is* campaign is a collaboration between The Safeway Foundation and the Entertainment Industry Foundation to raise awareness and improve the health of hungry children.

EIF
ENTERTAINMENT
INDUSTRY FOUNDATION

The Safeway Foundation and the Entertainment Industry Foundation are 501(c)(3) tax-exempt organizations. Photo by: Nigel Parry

NEWS

CONTENTS

- 8 Microsoft's 7 biggest new hardware reveals
- 15 Hands on: Microsoft's Surface Book is a stunner
- 20 Hands on: Microsoft's Surface Pro 4 outdoes itself
- 26 Surface Book and Surface Pro 4 chips
- 34 Hands on: Yes, Windows Phone fans, the Lumia 950 XL is your long-awaited flagship
- 39 Why Microsoft's audacious vision for the future of computing is finally ready
- 45 Intel regrets skipping Broadwell desktop CPUs
- 47 AT&T unlimited data plans now allow 22GB per month without throttling

Microsoft's 7 biggest new hardware reveals: Surface Book laptop, Windows 10 Lumias and more

BY BRAD CHACOS



WOW. JUST...WOW.

Going into Microsoft's massive device launch event, everyone knew that the focus would squarely fall on the intersection of physical and digital—new Microsoft devices that showcase everything possible with Windows 10. What we didn't expect was just how convincingly Microsoft would manage to push its vision for convergence between hardware and software, or how damn sleek and sexy Microsoft's in-house hardware would look.

From a Surface-powered MacBook rival to Lumias that appear well worth the wait, here are the seven biggest reveals from Microsoft's hardware blitz.

Surface Book

The surprise star of the show, the 13.5-inch Surface Book is the result of the Surface team's wondering "what if we can do for laptops what we did for tablets?" The answer: something awfully compelling.

The sleek, sexy Surface Book leans on Microsoft's decade-plus of experience designing keyboards and the Windows 10 team's precision trackpad wisdom to deliver what Surface head Panos Panay claims is a top-notch ergonomic experience—always a key selling point in laptops. And while the Surface Book was created to be "the ultimate laptop," its screen actually detaches, held in place by a Lenovo Yoga-like "dynamic fulcrum hinge" strengthened by Microsoft's "muscle fiber."

This thing holds up spec-wise, too, with a quad-core Intel Skylake processor, up to 1TB of storage and 16GB of RAM, and a discrete Nvidia GeForce GPU to drive the display's 6 million pixels. Ounce for ounce, Panay said, this is the most powerful 13-inch laptop ever, with twice the power of the MacBook Pro. See our Surface Book reveal in this issue. But that's just the tip of the iceberg!





Surface Pro 4

The Surface Book may have been the highlight, but the Surface Pro 4 pulled no punches after both Google and Apple revealed Surface clones of their own in the recently.

This is the thinnest and lightest Surface yet—Panay said it could've been thinner if Microsoft had jettisoned USB 3.0 (the tablet retains one such port)—but it's no performance slouch, with a new Intel Skylake processor and the same storage and memory options as the Surface Book. The display's also been upgraded, ditching the bezels to pack 5 million pixels into the expanded 12.3-inch screen.

But the real story, as always, is how the Surface Pro 4 acts as Windows 10's paragon. The tablet packs the thinnest cover glass ever to provide better stylus support. Holding the Surface Pen's button summons Cortana, which can then answer your voice queries. Any web searches conducted with Cortana open in the Edge browser, the results of which you can mark up with the Surface Pen to complete this virtuous circle.

The Surface Pro 4's camera and new Touch Cover were designed to take advantage of Windows 10's killer Windows Hello biometric technology, and the Surface Pen comes with all sorts of options now.



Lumia 950 and 950 XL

Windows Phone has been languishing ever since Microsoft purchased Nokia. Most of the Nokia staff has been laid off, and there hasn't been a new Windows Phone flagship released in over a year. That ends with Microsoft's Lumia 950 and 950 XL, which bring Windows 10 to the mobile market with a bang.

The duo shimmers with high-end touches: high-quality 20-megapixel cameras, a water-cooled CPU (what?!), high-resolution displays, and USB-C ports are one hell of a spec list.

But as with the Surface devices, it's what these Lumias do with their underlying software that's almost more impressive. These show what's possible on a phone powered by Windows 10 Mobile. The front cameras support Windows Hello, so the phones automatically and almost instantly unlock when you hold them up. The Lumia 950 and 950 XL also support Continuum, the killer Windows 10 Mobile feature that lets your handset perform like a full-blown Windows 10 PC when it's connected to an external monitor, thanks to the power of Windows 10's universal apps.

Check out our Lumia 950 and 950 XL coverage in this issue for more info.



Microsoft Band

Like the Surface and Lumia devices, the new Microsoft Band (go.pcworld.com/msband)—not the Band 2, just *Microsoft Band* again—merges hardware with software to create experiences that users simply can't find on other devices and operating systems.

The new Band sports a sleek, curved Gorilla Glass 3 display and deeper Cortana integration, but the real story here is how the sensor-laden device communicates with the cloud-based smarts of the Microsoft Health app to deliver actionable, personalized data to you. The second-gen Band adds yet another sensor, a barometric sensor for elevation tracking. The blend of hardware and software can track your usable oxygen levels and know when you're merely practicing your golf swings or tearing up the fairway—a level of granularity you won't find on other watches or fitness bands.

HoloLens

Microsoft didn't have much new to share about its intriguing augmented reality headset, but it did show off a new game, Project X-Ray, that turns your home into an alien battlefield with the help of a mysterious new controller.

Holographic aliens are always fun, but the real meat came from Windows chief Terry Myerson's more pedestrian announcement at the end of the little show: Developers can apply for a HoloLens development kit (go.pcworld.com/hololensdevkit), which will then be released in the first quarter of next year for \$3,000. Not \$350, like the Oculus Rift's dev kits. \$3,000. *Hot damn!*

Windows 10 on Xbox One

The Windows 10-powered "New Xbox Experience" for Xbox One is already being put through its paces by beta testers, but if you're not one of the chosen few, be patient. Myerson said Windows 10 will come to all Xbox One users in time for the holidays, along with the capability to stream backward-compatible Xbox 360 games from the console to Windows 10 devices. Yay!



Windows 10

There's been a core theme underlying all of these hardware announcements: Windows 10. And Windows 10 is on a roll.

The operating system's already claimed 110 million installs in the mere 10 weeks since its launch, Myerson revealed alongside some other nifty Windows 10 stats, and people have asked Cortana more than a billion questions already. To celebrate, Myerson announced that Facebook's bringing universal Facebook, Instagram, and Messenger apps to the Windows 10 ecosystem.

Microsoft's no doubt hoping that all these new devices highlight what Windows 10 is capable of when it's included in more holistic hardware design, which will help push the operating system toward its stated 1 billion user goal. If Microsoft's partners can pump out PCs and phones that are half as compelling as the Surface and Lumia lineup revealed, Windows 10 might just reach that goal...someday. 🍌



Hands on: Microsoft's Surface Book is a stunner as both a tablet and a laptop

BY MARK HACHMAN

MICROSOFT CALLS THE new Surface Book two-in-one the “ultimate laptop.” As a 2-in-1, it’s more than that. Undocked, the Surface Book is a massive 13.5-inch 3K tablet. Dock it to its base and it becomes a notebook capable of gaming, complete with its own discrete Nvidia GPU. And it’s twice as powerful as Apple’s MacBook Pro.

The secret? A flexible, articulated hinge that stabilizes the entire laptop, allowing it to recline and fold forward like a regular laptop, and fold backward to a comfortable angle. In terms of flexibility, the Surface Book doesn’t quite match up to the Surface Pro 3. But that’s forgivable, given its other advantages.



Watch the
video at
[go.pcworld.
com/surface
bookvid](http://go.pcworld.com/surfacebookvid)



All told, the Surface Book reminds me of the Chromebook Pixel: the premier example of what its ecosystem can achieve. The Surface Book will command a premium price, as well: \$1,499 for the base Core i5 model, \$1,899 for the core i5 model with the discrete GPU, and \$2699 for a full-boat Core i7 model with discrete GPU. Preorders of the Surface Book are currently underway.

Wow. *Wow.* A 3K tablet that converts into an honest-to-god notebook, complete with a discrete GPU and a full terabyte of storage. *PCWorld* staffers immediately began lobbying for a Surface Book to replace their work-issued laptops.

The special hinge on the Surface Book can perform all kinds of interesting tricks.

Hands on: What's not to love?

As a refresher, here's a quick rundown of the Surface Book's specs: The 13.5-inch, 3000-by-2000-pixel display uses Microsoft's PixelSense technology, which supposedly does a superior job with finger, stylus,

and palm detection. Inside is a 6th-gen Intel Skylake chip, either a core i5 in the base models, or a Core i7 in higher-end models. An undisclosed Nvidia GeForce mobile graphics processor is available in select core i5 and core i7 SKUs. You'll have your choice of either 8GB or 16GB of RAM, and 128GB, 256GB, 512GB or a full terabyte of SSD storage. Microsoft also promises a full 12 hours of battery life.

You can't help but love the specs. But I found the Surface Book a bit awkward while converting it from laptop to desktop mode.

The older Surface tablets connect to the Type Cover keyboard via a fabric hinge. It works pretty well, but there's always a tiny bit of flex. Worse still is the kickstand, which Microsoft has never quite figured out how to prevent it from digging into your thighs. The hinge solves all that, holding the monstrous tablet securely. It doesn't wiggle. Internal, toothlike hooks help secure the tablet to the base.

The Surface Book's base is connected to the tablet by something Microsoft calls "muscle wire." Run a charge through it, and it grips; eliminate that charge, and it releases. The dynamic fulcrum hinge

The keyboard is even better than the Surface Pro 4, with more key travel.





Here are the slots by which the Surface Book tablet connects to the base.

itself is segmented, like an arthropod.


About the only knock on the hinge is that it folds down to about 45 degrees on the diagonal—honestly, just fine for normal use, in my estimation, but not as far as the Surface Pro 3 reclines.

Undocking the Surface Book is interesting. Because the Nvidia GPU resides in the base (one of the connectors between the base and tablet serves as a PCI Express connector), you might think that you'd need to reboot the tablet to dock and undock it, as some external GPU solutions require. That's not the case. In fact, if an app is using the GPU and the tablet is undocked, you have only to quit the app to allow undocking, Microsoft executives said.

To undock the tablet, you press and hold an undocking key—just another key on the keyboard. A second or two later you'll feel the clamps detach, and a message will appear on the screen alerting you that you can undock the tablet. Because of the way the batteries are arranged, you'll receive only three hours of battery life undocked, however, so keep that in mind.

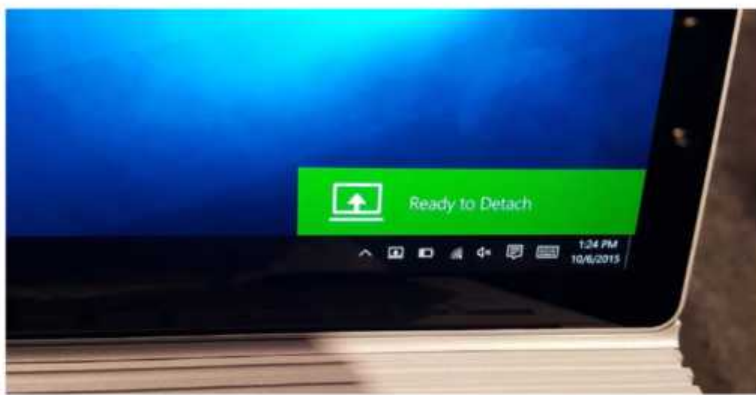
The clamps are magnetic, to boot. Docking the tablet is a bit ungainly—I could rarely get the tablet to dock cleanly, maybe once in

five tries. Otherwise, I was left trying to align everything just so. It's certainly not a deal-breaker.

Because it's a Surface Book, you'll find other improvements as well: the Surface Pen, which features 1,024 levels of sensitivity and docks right to the side of the Book via a magnetic clamp—no pen loop required. There's even Windows Hello, implemented via a depth camera, versus the optional fingerprint reader found in the Surface Pro 4 Type Cover. 



Hold down the undocking key (top, second from right) and the Surface Book preps to undock.



The undocking message.



Watch the
video at
[go.pcworld.
com/surface
pro4vid](http://go.pcworld.com/surfacepro4vid)



Hands on: Microsoft's Surface Pro 4 outdoes itself with more power and refined features

BY MARK HACHMAN

A MONTH BACK, and we'd likely be trumpeting Microsoft's new Surface Pro 4 as the next-generation of Surface. And it is. It's just that, compared to its newly announced, mic-dropping rockstar cousin—the Surface Book—the Surface Pro 4 loses a bit of its luster.

Shade your eyes from the Surface Book's dazzle, and the Surface Pro



4 has a lot to offer. Bumping up its processor to a sixth-generation Core, or Skylake, has boosted the performance by 30 percent over the Surface Pro 3 and 50 percent over the Apple MacBook Air, according to Microsoft. At a starting price of just \$899 (and available for pre order on Oct. 7, with availability on the 26th) the Surface Pro 4 is priced right, too.

Externally, the Surface Pro 4 boasts a new Type Cover. Complete with fingerprint reader, a new dock, and a revamped Surface Pen, which does away with that pesky pen loop entirely.

But wait: \$899 doesn't buy you a Core i-series chip. Instead, the low end of the Surface Pro 4 is powered by an Intel Core m3. Why Microsoft didn't hold back the Core m for a Surface 4 isn't clear. At the low end of the Surface Pro 3 lineup is an Intel Broadwell Core i3. The Surface Pro 4 skips to Skylake-powered Core i5 and i7 chips, while the Surface 3 uses a quad-core Atom chip—it all makes for an interesting mishmash at the low end of the spectrum. (Only the Core m3 and Core

Microsoft's Surface Pro 4 boasts a new Type Cover with a fingerprint reader, laptop-size keys, and a larger, more sensitive touchpad.

i5 versions are available for preorder, however.)

Microsoft helpfully spelled out the integrated graphics options: The Core m includes Intel's HD Graphics 515, the Core i5 includes HD Graphics 520, and the Intel Core i7 includes the Intel Iris graphics.)

Buy it for the specs, love it for the peripherals

The Surface Pro 4's display is a bit bigger than the Surface Pro 3's: 12.3 inches (2,736 x 1,824), as opposed to 11.5 inches. In part, that's because Microsoft pushed out the bezel, eliminating the Windows home key in the process. You'll use the soft home key instead, as the tablet (obviously) ships with Windows 10. As before, the display supports ten-finger multitouch. Memory options include 4GB, 8GB, or 16GB of RAM, and up to a whopping 1TB of SSD storage—the same

The kickstand has been slightly improved, so that it's quite apparent when you've reached the end of its range of motion, rather than stuttering to a stop.



storage options you'll find in the Surface Book. Microsoft uses a single USB 3.0 connector for expansion, as it did on the Surface Pro 3.

Moving to a Skylake chip slightly improved the battery life. Microsoft says that the Surface Pro 4 lasts nine hours, as opposed to just eight with the Surface Pro 3.

While newcomers to the Surface lineup will certainly appreciate the power, it's the external accessories that also help make the Surface Pro 4 intriguing.

An improved Surface Pen

First off, Microsoft revamped the Surface Pen, doing away with that awkward fabric loop that clipped previous pens on to the tablet. Now the Surface Pro 4 grabs the Pen magnetically, holding it tightly to the side of the tablet. It'll likely still work its way free in your laptop bag, however, because there's nothing preventing the Pen from sliding off.

Still, the new Pen boasts 1,024 levels of pressure, which works quite well with the PixelSense technology built into the display. There are even interchangeable nibs to vary the tip's shape. The idea is to make inking feel more natural on the Surface Pro 4 than it ever has, and I'd say Microsoft accomplished that goal. I also like the "eraser" on the top of the Pen, which doesn't necessarily erase a scrawl in one gesture, but acts more like a natural eraser, partially erasing each bit.

As before, tapping the eraser once launches OneNote; twice, and the tablet saves a screenshot. Press and hold, though, and poof!—



The new Surface Pen (available in five colors) also includes a choice of nibs.

Cortana appears, for those who have had some problems awakening her with “Hey Cortana,” presumably.

I’m intrigued by the new Type Cover. As before, it’s backlit. But the keys are spaced a bit farther from one another, more like the chiclet keys found on most laptop keyboards. They also have a bit more travel than the Type Cover used by the SP3. It felt completely comfortable under my fingers.

Some Type Covers will include a fingerprint reader next to the touchpad, which is also larger than the SP3’s Type Cover.

The Surface Pro includes an 8MP rear camera and a 5MP front camera, but neither is capable of recognizing you via Windows Hello. That’s been left to a small, optional fingerprint reader built into an optional Type Cover. Over time, I’ve found Windows Hello has had some problems with my unkempt beard—we’ll see if the fingerprint reader improves on that at all.

I’ll need to spend more time with the Surface Pro 4 before I know whether it’s as lovable as the Surface Pro 3. I think the unlooped Pen

The new Pen
magnetically
attaches to the
side of the
Surface Pro 4.





may prove to be annoying. But Microsoft seems to have made a great tablet even better, and only a showstopper like the Surface Book could detract from that achievement. 🍷

Some Type Covers will include a fingerprint reader next to the touchpad, which is also larger than the SP3's Type Cover.

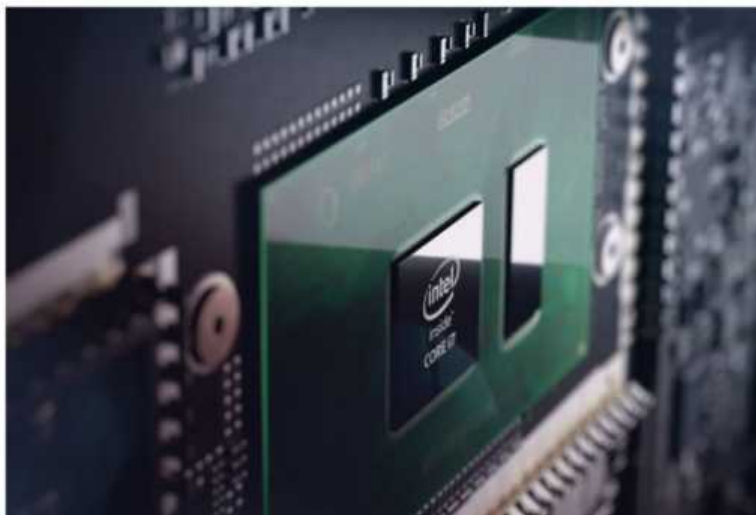
Here are the details of the Surface Book and Surface Pro 4 chips, and why they matter

BY GORDON MAH UNG & MARK HACHMAN



MICROSOFT HAS CLEARED up the mystery about what processors are inside the new Surface Book and Surface Pro 4, and here's the answer: The high-end Surface Pro 4 contains a dual-core Core i7 Skylake chip, while the Surface Book uses a faster, also dual-core, version.

Specifically, the high-end “clipboard” tablet portion of the Surface Book uses a dual-core Intel Core i7-6600U chip with Intel's HD Graphics 520 integrated GPU inside, Microsoft confirmed. The premium version of the Surface Pro 4 uses a Core i7-6650U with Intel's premium graphics, the Intel Iris 540.



What CPU
is inside the
Surface Book?
We now know.

Microsoft also confirmed some details of the GPU inside the base of the Surface Book. “[The] Surface Book with the optional discrete GPU uses a custom Nvidia GeForce GPU designed for Surface Book and based on the Maxwell architecture. Featuring 1GB GDDR5 high-speed memory, it was customized to deliver accelerated graphics performance within Surface Book’s versatile form factor,” Microsoft said in a statement.

Microsoft also revealed which processors are used in the other versions of the Surface Book and Surface Pro 4, but not the clock speeds.

Why this matters: You could be paying \$2,699 for the premium version of the Surface Book. So, is it worth it?

Much of the confusion was caused during the unveiling of the Surface Book, when Microsoft’s corporate vice president for Surface Computing Panos Panay said that “by adding the discrete GPU, two extra processors, it fundamentally makes Surface Book two times faster than the MacBook Pro.” That had a lot of folks wondering if Microsoft hadn’t somehow magically jammed a quad-core CPU into the thin tablet body of the Surface Book.

Here's what's inside

Here's what Microsoft told *PCWorld* about the specs of each Surface Book and each Surface Pro 4. The sixth-generation chips refer to the Skylake processors that we reviewed earlier, at least on the desktop. Microsoft hasn't confirmed the clock speeds, but Intel's own spec sheets tell us what they are.

Surface Book:

- 6th Gen 2.6GHz Intel Core i7-6600U processor with Intel HD graphics 520
- 6th Gen 2.4GHz Intel Core i5-6300U processor with Intel HD graphics 520

Intel has a comparison chart of the two chips (go.pcworld.com/surfacebookchips) on its site.

Surface Pro 4:

- 6th Gen 2.2GHz Intel Core i7-6650U processor with Intel Iris graphics 540
- 6th Gen 2.4GHz Intel Core i5-6300U processor with Intel HD graphics 520
- 6th Gen 900MHz Intel Core m3-6Y30 processor with Intel HD graphics 515

You can compare these three chips on Intel's site (go.pcworld.com/surfacechips).

Which Surface Book to buy: Core i5 or Core i7?

With identical graphics cores, the main difference between the Core i5 and the Core i7 appears to just be pure clock speed, so the better deal for performance per buck goes to the Core i5 chip.

Sometimes Intel turns features on or off based on where it wants the chip to fall in its performance hierarchy. For example, some Core i7 chips may contain its vPro technology, while some Core i5 CPUs may

not. With the Surface Book, both CPU models will support vPro which enables manageability in a corporate IT environment.

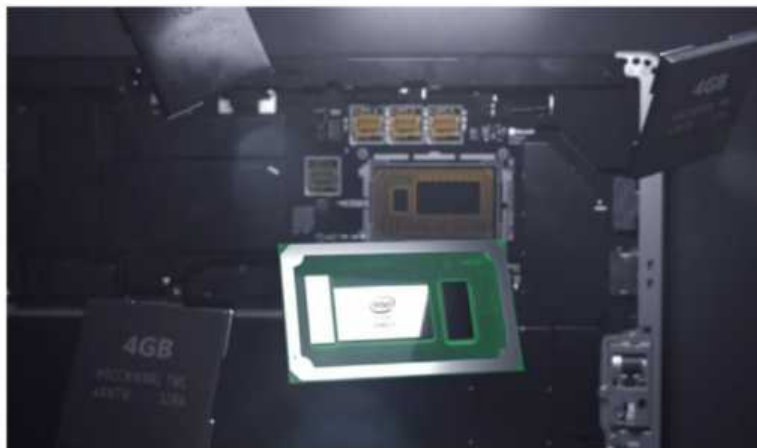
From a pure performance perspective, based on how previous Intel model numbers have gone and our testing of the desktop Skylake chip, we predict that you might see a 15-percent difference between the two based on CPU-intensive chores. (Yes, and like a meteorologist, you can't hold us to it unless we're right.)

Therefore, you'd probably be fine buying the Core i5 version of the Surface Book with discrete graphics and 256GB SSD for \$1,900 instead of shelling out \$2,100 for the Core i7 Surface Book with discrete graphics and a 256GB SSD. Most of you won't notice the difference unless there's some other key difference between the configurations that we're missing.

What about the CPUs in the Surface Pro 4?

Unlike the Surface Book, here you should choose wisely. While the CPUs in the Surface Book don't differ dramatically, the SP4's brains matter far more.

The highest end Surface Pro 4 uses Intel's Iris Graphics with 48 execution units and should offer rather decent performance. In our October Skylake Core i7-6700K review , you'll see that the desktop



Your CPU
choice on a
new Surface
Pro 4 will
matter more
than on the
Surface Book.

chip with its Intel HD530 graphics—a step down from the Surface Pro 4 with the Core i7—pushes 54 fps in Tomb Raider when set to normal and at 1366 x 768 resolution. It's not unreasonable to expect the Surface Pro 4 to be close to that or possibly exceed it (there are differences in cooling and memory bandwidth that could impact performance). Basically, "light-duty" gaming is definitely a feature of the Core i7 Surface Pro 4.

The midrange Core i5-based Surface Pro 4 will be slower, but in the same performance ballpark as the Core i7 unit in, say, Photoshop. But it will take a definite back seat in graphics performance, which means "lighter duty gaming" or graphics tasks.

The really interesting changeup is that Core m3-6Y30 part within the entry-level Surface Pro 4. It won't be as fast as the two faster SP4's in any CPU task, such as Photoshop or video encoding, and it'll also be third-place in graphics, too. But the significantly lower power consumption—and the significant boost in battery life—may be worth the trade-off.

Depending on how Microsoft configured the chip to run in the Surface Pro 4, it could offer truly stupendous battery life that the two hotter and faster CPUs can't touch. And it'll do this while offering better performance than say, an Atom X5- or Atom X7-based Surface 3.

Surface Pro 4, it could offer truly stupendous battery life that the two hotter and faster CPUs can't touch.

What Surface Pro 4 to buy

With this information in hand, the sweet spot for performance for the pre-configured models is the Core i5 with 8GB of RAM and the 256GB SSD. But that puts you into the \$1,430 price range, which is pretty painful.

Unfortunately, Microsoft's "customize" button is no help, as it just walks you through the increasingly expensive Surface Pro 4 units.

Picking the Core m3 version, for example, doesn't yield any actual



options. Ideally, if you're just a regular user and don't drive Photoshop all day, you should be able to buy a Core m3 SP4 with 8GB of RAM and 128GB of RAM. But you can't. Likewise, the options for the Core i5 version only let you pay for more storage or more RAM. For someone more sensitive to performance and price, it would be nice to get a Core i5-based Surface Pro 4 with 8GB of RAM and 128GB SSD.

To be fair, using a Dell XPS13 for a few months with "just" 4GB of RAM for general computing, including a bit of Photoshop, was fine thanks to the SSD. Still, there were a few occasions where 8GB of RAM would have been nice.

So, which one should you buy? Again, realizing that the three CPUs here will yield markedly different results, here's what we'd recommend:

• **Buy the Core m3 SP4 if your top priority is battery life, cost and more performance than an Atom-based Surface 3.** Just know it will

The basic specs of the Surface Pro 4 are the same, including its 12.3-inch display with a crisp resolution of 2736 x 1824 pixels.

be slower in graphics and CPU tasks than the other two units. One thing to be aware of: the Core m3 does not have vPro, which may be a deal-breaker for a managed corporate environment.

• **Buy the Core i5 SP4 if you do more intensive chores such as Photoshop, Lightroom, or light-duty video editing.** The extra 8GB will help, and the Core i5 should outpace the Core m3 in CPU tasks and be a little faster in graphics tasks. And yes, vPro is supported on the Core i5 version.

• **Buy the Core i7 SP4 if you really need faster graphics performance.** On the CPU side, you may see a 15 percent or so performance difference, too.

Again, this is based on how Intel CPUs have behaved for a few generations now and our testing of the desktop Skylake chips.

All we know about the graphics chip is its an Nvidia Maxwell-based graphics chip. Even this shot says nothing about the model.



But what about that graphics chip?

One part that's still shrouded in mystery is the discrete graphics chip Microsoft put in the Surface Book. Microsoft blew people's socks off with the Surface Book and the fact that it basically put external graphics into one part of its detachable computer that doesn't require a reboot when you swap between them.

What GPU though, we still don't know. Nvidia offered up nearly the same statement as Microsoft itself did.

"The new GPU is a Maxwell based GPU with GDDR5 memory," an Nvidia spokesperson said. "It was designed to deliver the best performance in ultrathin form factors such as the Surface Book keyboard dock. Given its unique implementation and design in the keyboard module, it cannot be compared to a traditional 900M series GPU."

"The new GPU is a Maxwell based GPU with GDDR5 memory."—Nvidia

The company directed me to Nvidia's blog, which confirms that it's an "8M" and has a 1GB GDDR5 frame buffer. So for that one chip, you'll have to wait a bit more to find out just what kind of performance the Nvidia GPU nets you.

Pre ordering is always a bit risky, especially with a somewhat radical new architecture like the Surface Book. But the picture is now much more clear than it was before. Just be sure and pick what's right for you. 🖱

Hands on: Yes, Windows Phone fans, the Lumia 950 XL is your long-awaited flagship

BY MARK HACHMAN

I HELD THE Lumia 950 XL in my hands. This is the Windows Phone flagship we've been waiting for, the phone that will lead its ecosystem.

But where's Windows Phone going? Logic tells me there's no way Microsoft can resuscitate the market. Simply gaining a little ground won't be enough—it can't survive unless it can sit respectably near to Android and iOS in market share.

After spending a little time with the Lumia 950 XL, I can consider the possibility that maybe, just maybe, not all is lost.



Watch the
video at
go.pcworld.com/lumia950xlvid





A solid CPU and camera make the new Lumia

A nonstop trickle of rumors slowly revealed the specs of the Lumia 950 XL (as well as the 950 and 550) before Microsoft showed it off at its press event, so the announcement didn't reveal any surprises.

As the names suggest, the Lumia 950 XL is the largest of the phones, with a 5.7-inch, 2560-by-1440-resolution AMOLED display, an octa-core Qualcomm Snapdragon 810 processor, and a 3340 mAh battery.

I couldn't verify which Windows 10 Mobile build the phone was running, but the demo 950 XL I tried felt snappy, without any of the lag that afflicts phones that have been upgraded to Windows 10 Mobile. It seemed like a fast, smoothly running phone.

There's a USB-C charging port in the lower edge of the phone. Microsoft says you can charge it to about 50 percent in 30 minutes or so. Headphones plug into a port in the top.

I snapped a few shots with the Lumia 950 XL camera, and they looked fine on the display, although that doesn't mean much. I do like

Say what you

want about the Galaxy Note, which popularized the phablet concept. Microsoft pretty much invented the phablet with the 6-inch Lumia 1520 (left), compared against the 950 XL and 950 (right).

the fact that the phones boast camera buttons, which give you immediate access to the camera so you don't need to fiddle with apps.

There are the three middle buttons on the phone's edge: That's a slight change from the previous Lumia designs, which placed the middle power switch in a separate location, and made the volume up/volume down buttons a single rocker switch. I was confused the first time I used it, but it shouldn't be a difficult adjustment to make.

Phones like the Lumia Icon feel substantial, due in part to the metal used in their construction. In contrast, the recent Lumia 640 feels light and plasticky—not quite cheap, but it doesn't scream quality, either. The 950 XL feels like a nice combination of the two: solid, and with a weight that sits comfortably in the hand rather than weighing it down. I think the back is made of plastic, but if so, it feels more rigid than Microsoft's more recent midrange phones.

The new phones also include a version of Windows Hello, which uses an iris reader to identify you. I wasn't able to unlock the phone (the phones were locked to the demo personnel) or test any of the phone's

The Microsoft Lumia 950 XL

has a 20MP rear camera (shown) as well as a 5MP front camera .





connected features. I was able to try out the iris reader for myself, however. It shines a low-power red light into your eye. You need to stick your eye close to it, so it can read it. It didn't seem especially painful when I tried it, though I can't vouch for its accuracy, obviously.

A week or so ago, I advised a coworker who was curious about Windows phones to look elsewhere, to Android. He bought the latest Note 5. I'm sure he doesn't regret his purchase. I will say, though, that he may have jumped the gun. If you're a Windows phone fan, don't make the same mistake.

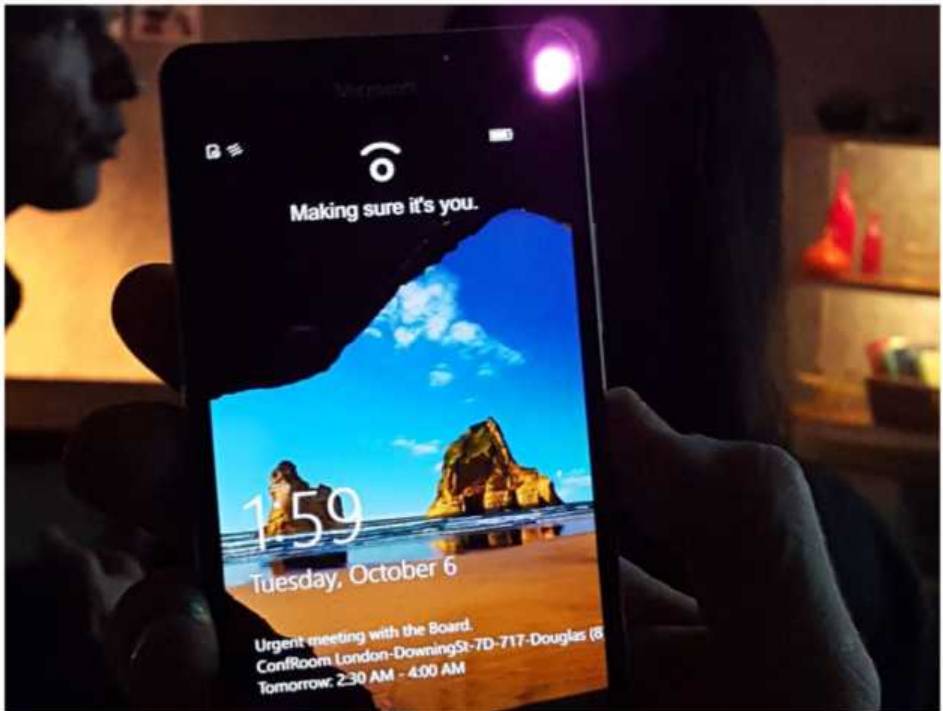
We need to acknowledge a few harsh realities: the lack of apps (though Facebook did join the universal app party recently), and no word on which carriers are going to sell these phones, although we do know they'll be priced at \$649 and \$549 for the 950 XL and 950,

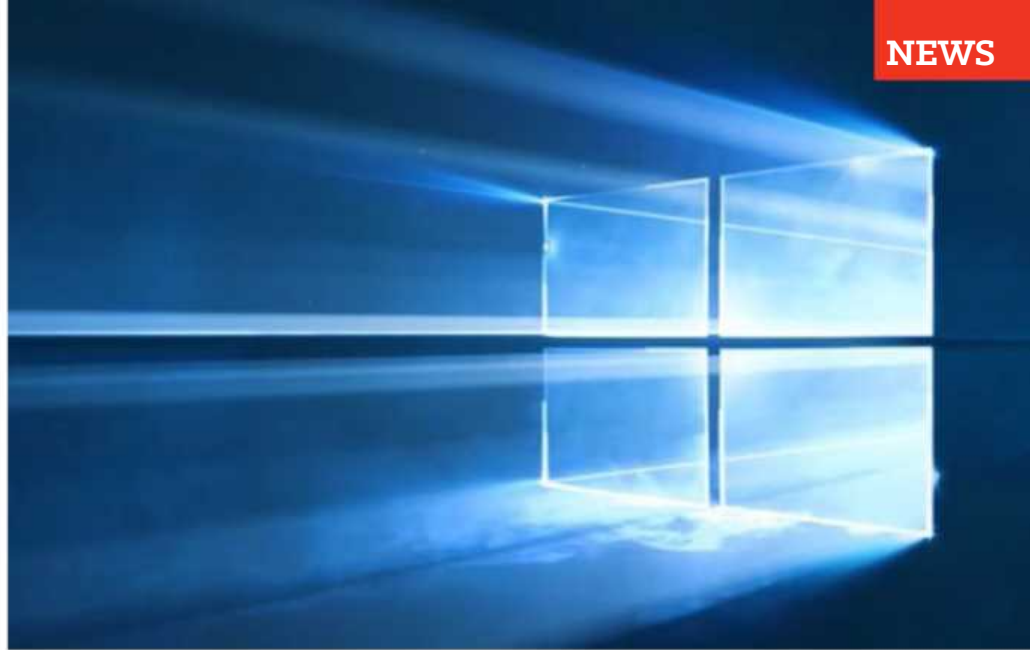
There are the three middle buttons on the phone's edge: That's a slight change from the previous Lumia designs.

respectively. Perhaps Microsoft will simply sell them unlocked, direct from its online and physical stores, and call it a victory for the consumer.

I'll admit I'm pessimistic—the faint, bright light of these flagships could be extinguished in a year. At least Microsoft will go out fighting, and that's great to see. 🔌

The Lumia 950 XL and its red iris reader can log you in using Windows Hello.





Why Microsoft's for the future of computing is finally ready for prime time

BY BRAD CHACOS

MICROSOFT'S AUDACIOUS VISION for Windows devices that seamlessly blend hardware with software in a unified, holistic experience is finally bearing fruit, after being stuck in a morass for years.

The company's been inching toward this experience ever since it revealed Windows 8, with its touchscreen support and Metro interface. Just last year, the Surface Pro 3 finally became the first piece of kit that truly delivered on Surface's core ideals, one-upping its flaw-ridden predecessors by delivering no-compromise hardware built around key Windows features; witness how pressing the Surface Pro 3's pen summoned OneNote, for example.

But the Surface Pro 3 still wasn't immaculate. The reason: Windows 8.

The hardware may have matured to match Microsoft's vision, but Windows itself still hadn't.

Everything's different with Microsoft's just-revealed hardware lineup, from the Lumia 950 to the Surface Book laptop to the new Band, and it's all thanks to Windows 10. For the very first time in the modern era, PC hardware and Windows software are singing in perfect harmony, and it couldn't sound any sweeter.

Why the wait?

Simple: Windows 8 launched prematurely.

I mean, not really. Microsoft had to push the touch-friendly Windows 8 out when it did, or risk irrelevance in the face of the skyrocketing popularity of Android and iPhone. By the time Windows 8 launched in October 2012, it already felt very, very late. But it was clearly rushed out the door, and worse, the PC hardware ecosystem wasn't ready to support a brave new future full of 2-in-1 hybrid devices, as evidenced by the utter lack of touchscreen devices available during Windows 8's first holiday season.

Over time, though, things got better, as Microsoft's ambition and



The Surface

Pro 2 was good, but not great, thanks to hardware and software that both failed to achieve Microsoft's vision.



the fear of potential tablet dominance spurred hardware makers into action. Intel began focusing on eking improved efficiency out of its PC chips, rather than putting the pure performance pedal to the metal, culminating in the new Skylake processors that deliver twice the potency for one-quarter of the thermal power of five-year-old chips, and scale all the way down to just 4.5W. Nvidia's Maxwell architecture for GeForce GPUs is a masterpiece of energy efficiency. SSDs just keep getting smaller and smaller and smaller.

It took years, but PC hardware's finally able to realize a thin, light, portable future.

Windows 8 may have been the catalyst for the change, but it wasn't up to powering truly compelling mobile hardware, either. Even Intel's then-CEO reportedly acknowledged that the OS was less-than-complete when it shipped, a sentiment echoed by the lackluster consumer response to Windows 8. The operating system tossed legacy desktop users out in the cold to offer a disjointed, cobbled-together mobile experience.

Windows underwent an evolution of its own after Windows 8's

Windows 8
was, uh, *half-baked*, to put it nicely.

launch, implementing rapid-response updates and listening to customer feedback in ways that would've been unthinkable under previous Microsoft regimes. Longtime CEO Steve Ballmer resigned and was replaced by Satya Nadella, who instituted a strong focus on Microsoft services and designing for a “mobile-first, cloud first” world.

The result: Windows 10. It's still not perfect, but it rectifies Windows 8's most egregious flaws, weaving together the best of Windows 7 and Windows 8 in a way that lets a PC be a PC and a tablet be a tablet, delivering a consistent experience across devices thanks to the power of Microsoft's services. The software is now ready to meet Microsoft's years-old vision for portable computing.

Which brings us to today's Windows 10 hardware blitz.

Surface Books and Lumias and Xboxes, oh my

Every new device and every announcement Microsoft stem from the marriage of Windows 10 with hardware designed to embrace its advantages.

The Surface Pro 4 may be merely iterative hardware-wise compared to the Surface Pro 3, but technological advancements allowed Microsoft to make it even thinner, lighter, and more powerful. More impressively, the SP4's

new features embrace Windows 10's new features to the fullest. Windows Hello facial recognition is built into the camera. Holding the Surface Pen's button down summons Windows 10's Cortana digital assistant, which can then answer your vocal queries. The web searches Cortana surfaces in the new Edge browser can be marked up with the pen, closing the virtuous hardware/software loop.

The Surface Book shows what's possible when you pair



**Microsoft's
Surface Pro 4.**



The Surface Pro 2

was good, but not great, thanks to hardware and software that both failed to achieve Microsoft's vision.

thoughtful laptop design with Windows 10's sensibilities. Beyond the Surface Pen and Windows Hello support, the Surface Book reveals that you can have powerful laptop performance in a thin-and-light design and still detach the screen to have a fully functional Windows tablet experience. The battery-sipping Nvidia GPU gives you performance without a power hit.

The new Lumia 950 and 950 XL, meanwhile, show what can happen when you marry powerful new mobile hardware with Windows 10's killer Continuum feature, allowing you to use your phone as a full-blown Windows 10 PC when it's docked to an external display. And their native Windows Hello facial unlocking looks awesome.

The new curved-display Microsoft Band offers few fresh hardware



Microsoft's


Lumia 950 and 950 XL Windows Phones.



The new,
curved-display
Microsoft
Band.

features, but the way it blends a bevy of wrist-based sensors with the cloud-based smarts of the Microsoft Health app creates potent, personalized “big data” insights that you just won’t find in any other fitness wearable or watch.

All of these experiences, as well as the new experiences promised for HoloLens and Xbox, wouldn’t be possible if hardware and software weren’t perfectly in sync. There’s a reason that Windows 8 and Windows Phone 8 failed. And this onslaught of Windows 10 devices may still falter. The Windows Store and its device-scaling universal Windows apps underpin many of Windows 10’s most impressive capabilities, and while things are looking up on that front, Microsoft’s app store still has a long row to hoe.

But damn if it isn’t impressive on paper. For the first time ever, everything’s in place for Microsoft to realize its ambitious vision for Windows 10 devices. Now we wait and see whether the rest of the world will embrace Microsoft’s future, too. 



Intel regrets skipping Broadwell desktop CPUs

BY JARED NEWMAN

Broadwell C is technically a “low power” chip with a TDP of 65 watts.

AN INTEL EXECUTIVE has admitted that the chipmaker goofed up by passing over the tower desktop PC market with its 5th-generation Broadwell processors.

With Broadwell, Intel focused mainly on laptops, miniature desktops, and all-in-ones. This left traditional desktop users with no new socketed CPU options beyond 4th-generation Haswell, which first arrived in 2013. Although Intel finally coughed up a pair of Broadwell desktop chips this past summer, the company launched its high-end

6th-generation Skylake CPUs very shortly thereafter.

At a recent industry conference, Kirk Skaugen, senior vice president and general manager of Intel's Client Computing Group, admitted that skipping desktops with Broadwell was a poor decision. Between the end of life for Windows XP in 2014 and the lack of new desktop chips, Intel hasn't given tower PC users any good reasons to upgrade in 2015.

"We made an experiment and we said maybe we are putting technology in to the market too fast, but let's not build a chip for the mainstream Tower business, more than a \$10 billion business," Skaugen said, as first reported by WCCFTech. "Turns out that was a mistake."

The silver lining for Intel is that it's now looking at pent-up demand for Skylake CPUs. The whole reason Skaugen admitted Intel's error to investors was to explain that things are now looking up. In PCs as a whole, Intel is expecting "slightly better than seasonal or high-end to seasonal" demand this quarter.

The impact on you at home: In the near future, the lack of new desktop chips will be a moot point with the arrival of Skylake CPUs. But in skipping Broadwell, Intel appears to have learned a lesson: The users who make up the \$10 billion desktop tower business actually care about having the latest and greatest. In the long run, it's unlikely that Intel will "experiment" with neglecting them again. 🔌

AT&T unlimited data plans now allow 22GB per month without throttling

BY JARED NEWMAN

AT&T CUSTOMERS WHO'VE hung onto their unlimited data plans now have a lot more full-speed data to play with.

According to AT&T's website (via DSLReports; go.pcworld.com/att-legacyplans), users with legacy unlimited data plans can use up to 22GB of data per month without getting throttled. After that, users will see slower speeds in congested areas, with the degree of throttling depending on the amount of congestion. (Users will also get a warning when they've exceeded 16.5GB, which is 75 percent of 22GB.)

This is a major change from AT&T's previous policy, which began throttling unlimited data users at 5GB in a congested area. In an even older policy, AT&T throttled users at just 3GB for 3G/4G HSPA+ networks and 5GB for 4G LTE networks, whether they were in a congested site or not. (Some users complained that throttling began at just 2GB.)

Why this matters: AT&T stopped offering unlimited data plans to new customers in 2012. While existing customers have been allowed to keep their unlimited data, AT&T has severely curtailed the benefits of those plans through strict throttling policies and the inability to tether a tablet or computer without additional fees. Subscribers who've stuck with their unlimited plans through it all are now being



handsomely rewarded, especially as streaming video, photo sharing, and streaming music cause data use to climb.

Under pressure

AT&T says the data expansion is thanks to its network management practices, which have “continued to evolve over time to benefit our customers and take advantage of the billions we have spent to expand and augment our networks.”

AT&T stopped offering unlimited data plans to new customers in 2012.

What AT&T doesn’t readily acknowledge is that it’s been smacked by lawsuits from both the Federal Communications Commission and the Federal Trade Commission over its lack of disclosure about throttling. AT&T is now facing a \$100 million fine (go.pcworld.com/att-fine) from the FCC, while the FTC’s lawsuit is still ongoing.

It’s also worth noting that AT&T, like all wireless carriers, is now subject to the FCC’s net neutrality rules, which allows for reasonable network management, but only for “primarily technical” needs. Potentially, an unlimited plan with an artificially low data cap could run afoul of those rules.

AT&T’s new approach is similar to that of T-Mobile, which begins throttling unlimited data users at 21GB. Sprint and Verizon don’t target heavy data users for throttling, though some Sprint plans have lower bandwidth priority (go.pcworld.com/sprint-allinplans) than others. 📶

You might know **Joshua**.
He loves video games, and he
owns enough to know they're not
all meant for kids. That's why he
reminds his friends (at least the
ones that have kids) that they all
have **big black letters on the box**
to help parents find the ones that
are best for their families.

You can learn about those
ratings at **ESRB.org**



Los Angeles, CA



ENTERTAINMENT SOFTWARE
RATING BOARD



NOVELS ROCK 'N' ROLL
STAND-UP COMEDY JAZZ
VIDEO GAMES MOVIES
COMIC BOOKS TALK RADIO

EVERY NEW ART FORM HAS ITS FIGHT FOR FREE SPEECH.

OUR TIME IS NOW
FIGHT FOR YOUR VIDEO GAMES



V I D E O G A M E V O T E R S . O R G

Make smart purchases,
stay safe online.

CONSUMER WATCH



The price of free: how Apple, Facebook, Microsoft, and Google sell you to advertisers

Here's what popular services like Apple, Google, Facebook, and Microsoft collect—and what you can do about it.

BY MARK HACHMAN

JUMPING FROM WINDOWS 7 directly to Windows 10 has to be something like a farmer visiting Times Square. Live Tiles flash and *move*. A nice assistant named Cortana always hovers nearby. Click on the wrong spot and you could be whisked away elsewhere on the Web. And there are always people asking who you are, where you live, what you like...

Because the latest version of Windows is always asking for information

in the guise of being helpful, it's easy to think that Microsoft's the poster child for the collective attack on your digital privacy. But it's not.

In fact, there are plenty of other companies who feel perfectly entitled to *require* you to hand over your personal info before they open their doors.

On a day where Microsoft clarified (go.pcworld.com/w10privacy)

what it does with your data to try and soothe your fears, a Bloomberg feature profiled Facebook's "unblockable" (go.pcworld.com/unblockable) ads, while a new Google program revealed

that advertisers can now tune ads (go.pcworld.com/tuneads) to who you are just by knowing your email address.

This is the price of free: free email, free operating systems, free connecting with friends, free search. And while Microsoft has thrown itself on the ground, begging for forgiveness, you can make the argument that other companies are doing as much or more to mine your data.

Let's take a look.

Facebook

"...Facebook trackers are just about everywhere on the Internet. But because most of Facebook's 1.49 billion users routinely access the service through an app, the ads cannot be hidden using one of the many blocker tools now topping the download charts on Apple's App Store."—Bloomberg

At this point, Facebook represents its own self-contained ecosystem. Want to share baby pictures? Ping a friend to meet up after work? Chances are that you're making those connections on Facebook—connections that Facebook knows and can exploit for its gain.

The latest? Facebook is now pitching a program by which advertisers can market their products across TV and Facebook as a unified whole (go.pcworld.com/fbunifiedads), so that a trailer for the latest James Bond movie, for example, might run at halftime of "Monday Night Football"—or on news feeds of users who have "liked" a previous Bond

This is the price of free: free email, free operating systems, free connecting with friends, free search.

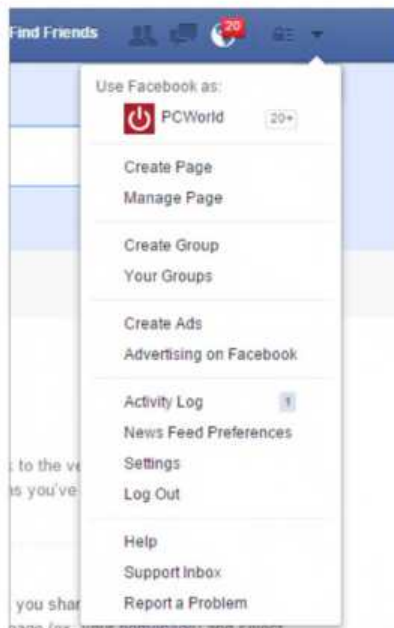
flick. And if that's not enough, advertisers will also gain the power to poll you about what you thought of them.

What information does Facebook collect? It's no secret that there's little "privacy" in Facebook's privacy policy (facebook.com/about/privacy). Here's a snippet:

"We collect the content and other information you provide when you use our Services, including when you sign up for an account, create or share, and message or communicate with others. This can include information in or about the content you provide, such as the location of a photo or the date a file was created. We also collect information about how you use our Services, such as the types of content you view or engage with or the frequency and duration of your activities."

Facebook knows your friends, what information you provide about them, what they say about you, what other sites you visit (if they include a Facebook "like" button, which most do), what you bought, what device you used to access Facebook, and much more.

What can I do about it? It's an amazing amount of information, although you can download it all right here (go.pcworld.com/fbyourinfo), using Facebook's Download Your Information tool. You can also check your Activity Log to see exactly what you've done since you've joined the service. Note that the latter choice is far less complete than the Download Your Information tool. You can also delete your account (go.pcworld.com/fbdelete), but Facebook reserves the right to keep information that others have shared about you. Because to Facebook, that information isn't yours.



Track your own history with Facebook's Activity Log.



Google

Google has become the de facto name in search (although I've since switched to Bing) and Gmail, Google Maps, and its other services now rank among the leaders in those categories. But all that "free" adds up to a huge amount of your personal information being traded away to create personalized, targeted ad experiences.

The latest? Google has launched a program by which your profile is now keyed to your email address. Dubbed Customer Match (go.pcworld.com/customermatch), the program ensures that an advertiser's "brand is right there, with the right message, at the moment your customer is most receptive," Google promises. So if you've previously asked a travel site to send information to your Gmail address, that site can sign up for Customer Match. Then when you're watching YouTube, that site "can show ads that inspire them to plan their next trip."

Google recently added native Gmail ads for all of its AdWords customers, meaning that you'll end up with interest-based advertising in your inbox unless you opt out (go.pcworld.com/googleadsoptout).

Google buries information

about what you do on the Web all over this place, including your Search History. But does anyone ever bother digging it up?

What information does Google collect? As with Facebook, there's a ton (go.pcworld.com/googlecollect): name, email address, telephone number, credit card (if you enter it), details on how you use Google's services, how you interact with other websites that use AdWords and other Google technologies, your device, search queries—the list goes on and on. Google will also store information in your browser via local browser storage—that goes beyond the snippets of code commonly referred to as “cookies”.

And if your information is “public,” it's fair game. “If other users already have your email, or other information that identifies you, we may show them your publicly visible Google Profile information, such as your name and photo,” the policy states.

If there's one thing that I don't see in Google's privacy policy, it's a portion that's specific to Android.

What can I do about it? Google actually allows quite a bit of freedom to tailor what information you provide to it—although it's betting that just a tiny fraction of you will ever access it, let alone limit that information. But it's all here in the Google privacy policy (go.pcworld.com/googlechoices): tweaks to allow you to turn off location tracking, voice searches, and other features; viewing and editing your preferences; adjusting your public profile; and much more. And you can download Google's data hoard, too.

Control your Google ads

You can control the ads that are delivered to you based on your Google Account, across devices, by editing these settings. These ads are more likely to be useful and relevant to you.

Your interests

You do not have any interests associated with your Google account. Interests are used to show you ads that are relevant to you. Interests will be added automatically as you use Google services or you can add specific interests.

Icons: A speech bubble with a checkmark and an empty box, a briefcase, a dog, and a guitar.

Apple

Apple may have said that it's making it very clear how it's using your data (go.pcworld.com/mwappleprivacy), but you'll probably agree the way it does so is far more obtuse than the other companies we've listed here .

The latest? The news surrounding Apple isn't so much how it's using your data, but how it's preventing content companies from having the same access. Its controversial ad

blocking technology built into the latest version of iOS 9 has roiled the advertising and media world alike. Part of this, of course, is that Apple makes the majority of its sales on hardware and app sales—not advertising—so it can take the high road.

What information does Apple collect? Apple's "privacy policy" (apple.com/privacy) can be summed up in three words: "We're for it." The policy doesn't do a great job explicitly listing what information it collects, most of it goes into more detail into what it *doesn't* collect. In all fairness, Apple appears to do a good job linking your preferences to an intermediary, anonymous series of ID numbers (sometimes linked to the Siri digital assistant) rather than "knowing" it is you.

Apple does say, however, that it will collect certain information such as your name, contacts, and songs in your music library, and send them to Apple servers using encrypted protocols—including your location, if that service is turned on. And your iPhone sends your anonymized location and calendar information, so it can predict when you'll have to leave to make your next appointment. Apple Music also links your preferences to an anonymous ID, and the News app uses your reading preferences to supply ads within the app.

What can I do about it? For all of its holier-than-thou attitude toward advertising, Apple doesn't put the process to opt out of



Here's how
to turn off
ad tracking
in iOS 9.

targeted advertising (go.pcworld.com/appleoptout) front and center. Time and again, Apple says that you can reset the identifier it uses to link you to the content you want to see, or opt out; however, that process is left to the user to discover for himself or herself.

Microsoft

Microsoft's a bit different than Facebook, for example, in that it owns

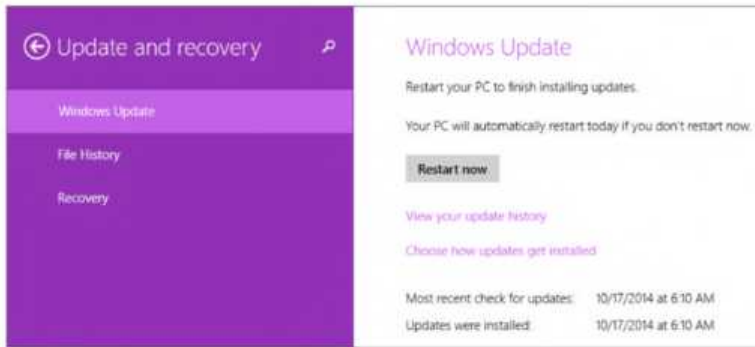
your operating system as well as its associated services. That means that it can peer into your OS and discover that a particular graphics driver was at fault, as the company pointed out in a blog post on recently. During the run-up to Windows 10, I complained about a driver issue (specifically a borked Intel 802.11ac W-Fi driver) on Twitter. Coincidentally or not, I was pushed a new driver the next day.

Microsoft admits to collecting information to personalize your experience, but says it does not scan your email to collect that. "Unlike some other platforms, no matter what privacy options you choose, neither Windows 10 nor any other Microsoft software scans the content of your email or other communications, or your files, in order to deliver targeted advertising to you," Microsoft senior vice president Terry Myerson wrote in a blog post.

What information does Microsoft collect? Microsoft also does a good job comprehensively spelling out what information it collects (go.pcworld.com/msprivacy): name and contact data, credentials, demographic data, payment data, and more. But don't buy the line



...and in
iTunes.



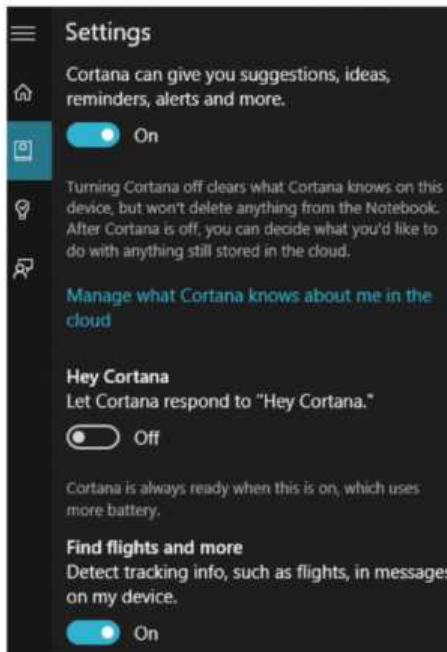
Allowing Microsoft

to see what's inside your PC isn't always the worst idea, as updates can be tailored to your PC's particular hardware.

that Microsoft doesn't read your email—the privacy policy states very clearly that it does. It not only reads the subject line and body of an email, but also the text or other content of an instant message, the audio and video recording of a video message, and the audio recording and transcript of a voice message you receive or a text message you dictate. *It just doesn't sell ads against it.*

There's also an additional layer of input that Microsoft samples, because it is an OS.

"Additionally, your typed and handwritten words are collected to provide you a personalized user dictionary, help you type and write on your device with better character recognition, and provide you with text suggestions as you type or write. Typing data



If you'd like, you can turn features like Cortana off.

includes a sample of characters and words you type, which we scrub to remove IDs, IP addresses, and other potential identifiers. It also includes associated performance data, such as changes you manually make to text as well as words you've added to the dictionary."

And that's just some if it.

What can I do about it? For a comprehensive primer, please refer to Ian Paul's guide to reclaiming your privacy in Windows 10 (go.pcworld.com/w10privacy), piece by piece, as well as Lincoln Spector's tip about turning off the Windows keylogger (go.pcworld.com/keylogger).

PCWorld

Hey, fair's fair, right? We can't really criticize other sites' privacy policies without publishing our own as well (idgcsmb.com/pcworld-privacy-policy/). Note that *PCWorld* uses cookies to help identify you—and if you've logged in, you'll receive a more optimized experience. But if you don't log in, that's fine too.

And yes, you can use an ad blocker or an anonymizer service with no penalty and still receive our news and features. Other sites allow limited access with anonymization turned on—you can still see public Facebook pages, for example, but there's no way you'll see anyone's Gmail page without the proper login and password.



Yes, your privacy is for sale

One of Robert A. Heinlein's most famous contributions to popular culture was an acronym: TANSTAAFL—There Ain't No Such Thing As A Free Lunch. That certainly goes for

today's online services. Bing, Outlook, Gmail, Yahoo Mail, and the like—they may not cost you a dime, but they're not free. The only sure way to avoid paying is to surf anonymously (go.pcworld.com/secretsurfing), never buy a smartphone, and never take advantage of a free Web service that you have to log in to. 🚫



Newly found TrueCrypt flaw allows full system compromise

BY LUCIAN CONSTANTIN

WINDOWS USERS WHO rely on TrueCrypt to encrypt their hard drives have a serious security problem: a researcher has discovered two critical flaws in the program.

TrueCrypt may have been abandoned by its original developers, but it remains one of the few encryption options for Windows. That keeps researchers interested in finding holes in the program and its spin-offs.

James Forshaw, a member of Google's Project Zero team that regularly finds vulnerabilities in widely used software, has recently discovered two vulnerabilities in the driver that TrueCrypt installs on Windows systems.

The flaws, which were apparently missed in an earlier independent audit of the TrueCrypt source code, could allow attackers to obtain elevated privileges on a system if they have access to a limited user account.

The original authors of TrueCrypt, who have remained anonymous, abruptly shut down the project in May 2014 warning that “it may contain unfixed security issues” and advised users to switch to BitLocker, Microsoft’s full-disk encryption feature that’s available in certain versions of Windows.

At that time a crowd-funded effort was already underway to perform a professional security audit of TrueCrypt’s source code and its cryptography implementations. The first phase, which analyzed the TrueCrypt driver and other critical parts of the code, had already been completed when TrueCrypt was discontinued. The auditors found no high-severity issues or evidence of intentional back doors in the program.

It’s impossible to tell if the new flaws discovered by Forshaw were introduced intentionally or not, but they do show that despite



professional code audits, serious bugs can remain undiscovered.

The first phase of the TrueCrypt audit project, performed by security engineers from iSEC Partners, a subsidiary of information assurance company NCC Group, covered the driver code, but “Windows drivers are complex beasts” and it’s easy to miss local elevation of privilege flaws, Forshaw said on Twitter.

The Google researcher hasn’t disclosed details about the two bugs yet, saying that he usually waits seven days after a patch is released to open his bug reports.

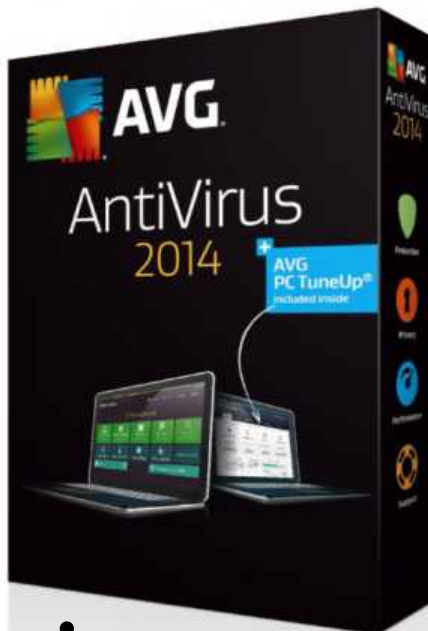
Since TrueCrypt is no longer actively maintained, the bugs won’t be fixed directly in the program’s code. However, they have been fixed in VeraCrypt, an open-source program based on the TrueCrypt code that aims to continue and improve the original project.

VeraCrypt 1.15 (go.pcworld.com/veracrypt) that was released recently, contains patches for the two vulnerabilities, identified as CVE-2015-7358 and CVE-2015-7359, as well as for other bugs. The program’s developer only flagged the CVE-2015-7358 flaw as critical and said that it can be exploited by “abusing drive letter handling.”

There are still many users of TrueCrypt or VeraCrypt, because it’s one of the few free options they have for encrypting their entire hard disks, including the Windows system partition. Microsoft’s BitLocker is not available on Home editions of Windows, which come pre-installed on many consumer laptops, and most other programs that can encrypt the system partition require a paid license.

Users who still use TrueCrypt should switch to VeraCrypt as soon as possible. In addition to patches for these two flaws, the program also has other security improvements on its predecessor. 🔌

The Google researcher hasn’t disclosed details about the two bugs yet, saying that he usually waits seven days after a patch is released to open his bug reports.



AVG's new privacy policy is uncomfortably honest about tracking users

BY JARED NEWMAN

WHILE ANTI-VIRUS FIRM AVG congratulates itself over a new easy-to-read privacy policy, users are up in arms over what that policy spells out.

The new policy (go.pcworld.com/avgprivacy), which took effect on October 15, makes clear that AVG will collect non-personal data such as “Browsing and search history, including meta data.” AVG says it collects this data “to make money from our free offerings so we can keep them free.”

It's rare to see a privacy policy that so plainly points out a company's

data collection methods and motivations, but that's the point. AVG recently put out a press release to celebrate its new document, which indeed uses lots of plain English and includes brief summaries of each section at the top. CEO Gary Kovacs even implored the rest of the tech industry to adopt similarly transparent policies.

But in making its privacy policy easier to understand, AVG has also opened itself up to a backlash. A post on Reddit (go.pcworld.com/reddit-avg) pointing out AVG's practices is currently at the top of the site's Technology section, with

thousands of upvotes and (largely angry) comments. Some of the practices mentioned in that Reddit post are things that AVG was already doing, such as keeping a list of installed applications, collecting the device's advertising ID, tracking search terms, and sharing that non-personal data with third-party partners.

CEO Gary Kovacs even implored the rest of the tech industry to adopt similarly transparent policies.

Still, the old policy didn't draw a fine line between collecting data for malware tracking, and using it for profit. There's also no mention of collecting users' browser histories in the old document. We've reached out to AVG to clarify how much of the privacy policy is new, and the extent to which the company is collecting browser history.

Why this matters: AVG's new policy illustrates exactly why companies tend to drown their data collection practices in legalese. There's no penalty for doing so, and being transparent only invites more outrage. In that sense, AVG at least deserves credit for helping users make informed decisions. Still, the idea of an anti-virus program tracking and monetizing your browsing history is unnerving, and if anything AVG ought to clarify that point further as it finalizes its new privacy policy. 🔒



Facebook is finally building a Dislike button

BY BRAD CHACOS

THE FABLED, LONG-REQUESTED Facebook “Dislike” button may finally become reality, CEO Mark Zuckerberg said during a recent Q&A session. But instead of being a catch-all “This sucks” identifier used to brand clickbait and racist memes from Uncle Homer with a scarlet letter, the social network’s considering rolling out the Dislike button for a more nuanced use: Empathy.

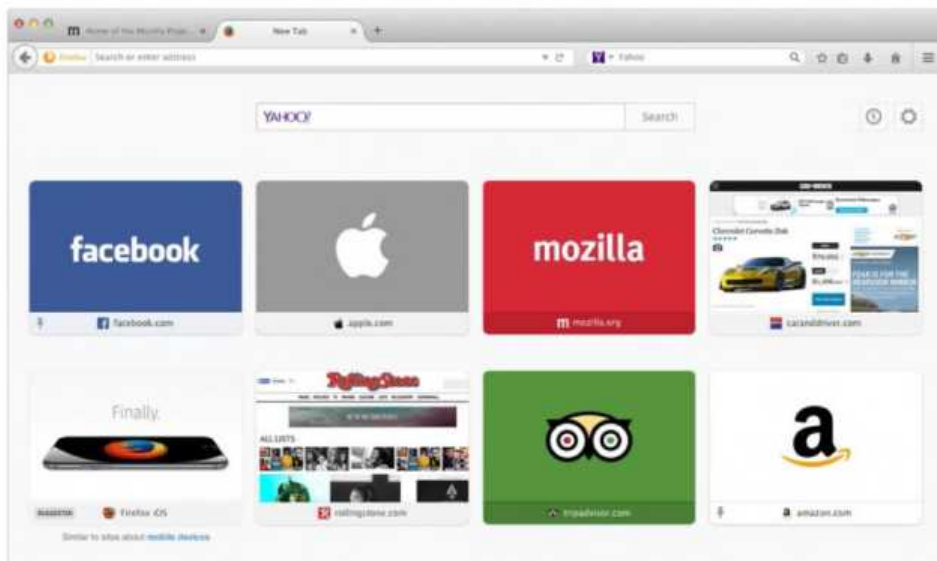
Facebook wants to limit use of the Dislike button to situations where the standard “Like” interaction feels crass, such as posts about deaths or divorces. “What they really want is the ability to express empathy. Not every moment is a good moment,” Zuckerberg said, according to *Time*.

Zuckerberg says Facebook’s “working on [a Dislike button] and shipping it,” with plans to start testing its implementation in the future.

The story behind the story: Facebook and Zuckerberg have long resisted the idea of introducing a Dislike button to the social network, wary of giving users an avenue to attack other people via a negative interaction. (Think of Reddit’s “downvote brigades” that swoop in to submerge posts that contain ideas the brigade disagrees with.) The Dislike button Facebook is now considering sounds like a much more nuanced approach, designed to combat an actual problem with the network—but Facebook’s going to have to stick the landing or it could turn out ugly.



Perhaps it’ll turn up as an optional flag that allows you to manually change “Like” to “Dislike” for a post? Time will tell, though Zuckerberg didn’t reveal any sort of expected time frame for the new feature to roll out. 🚫



Ads based on your browsing history quietly hit Firefox's New Tab page

BY BRAD CHACOS

IT'S OFFICIAL: FIREFOX is serving you targeted ads on the browser's New Tab page now. But before you grab your torch and pitchfork, it's not that bad.

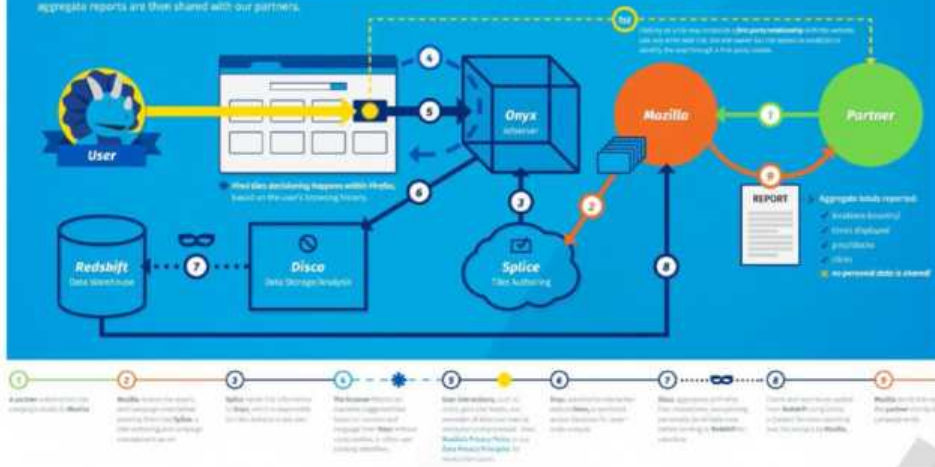
Mozilla quietly rolled out its Suggested Tiles feature in early August, Content Services VP Darren Herman announced (go.pcworld.com/fftilespartners) via Mozilla's blog. While the Directory Tile ads that appeared in Firefox (go.pcworld.com/ffads) in late 2014 are mere dumb display ads, Suggested Tiles tap your browsing history to show advertising that (theoretically) appeals to you.

How user data is protected on Firefox New Tab

Suggested tiles are powered by a recommendation system that acts on behalf of the user, delivering relevance while respecting privacy. Here is basically how it works: We only send a limited amount of data back to our tiles selection server, Onyx, and store that raw data in our storage and analysis server, Disco, for a short period of time before aggregating it in our data warehouse. High-level aggregable reports are then shared with our partners.

Still have questions?

firefox@mozilla.com



Suggested Tiles aren't a new Big Brother moment. They're clearly labeled, and Mozilla doesn't retain or share your individual user data—all Suggested Tile performance data is delivered to advertisers in aggregate, and all potential Tiles are downloaded from Mozilla's servers in bulk based on your country and language. The decision about which specific Suggest Tiles are shown to you happens right within Firefox itself, based on your browsing history, and you personally control your browser's user history the same way you always have.

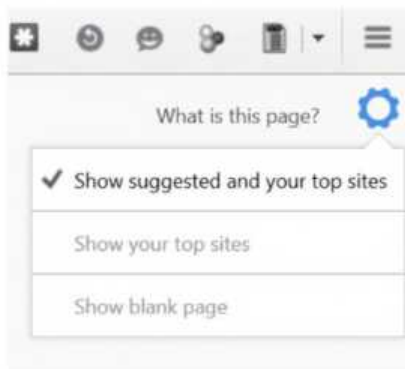
"With Suggested Tiles, we want to show the world that it is possible to do relevant advertising and content recommendations while still respecting users' privacy and giving them control over their data," Herman wrote when introducing the concept in May.

The impact on you at home: There's been a firestorm brewing around these ads, but Firefox's Suggested Tiles is advertising done

This infographic explains the Suggested Tile process in detail.

right: They're helpful without being intrusive or haphazard with your personal data. Mozilla deserves props for thinking through the entire process to make it as pro-user as possible—a rarity in the advertising world. And if you're strongly against the idea of ads on Firefox's New Tab page, you can disable both Suggested and Directory tiles by clicking the gear icon in the upper right corner of the New Tab page, then selecting any option *other than* Show Suggested And Your Top Sites.

Don't be hasty to do so, however. Firefox's share of the browser market has been slipping in recent months, and as a nonprofit organization, Mozilla could really use the extra money provided by advertising tiles. True stealth modes (go.pcworld.com/truestealthff) don't develop themselves, after all.



Some new tracking

That's not to say that Firefox's ads don't collect information about you whatsoever. In order to gauge the effectiveness of Suggested Tiles, Firefox collects data about how you navigate the New Tab page, a Mozilla representative told ZDNet. Here's everything that's sent to Mozilla:

- Language preference
- Tile ID
- How many times the Tile was displayed
- Where in the grid of tiles a Tile was displayed
- What interaction the user has with a Tile:
 - "Rolled over"
 - "Hovered over"
 - Pinned
 - Blocked
 - Clicked
 - Moved

“This data is associated with an IP address and is stored for a maximum of seven days, while Mozilla reports on the performance of the Tile,” the representative told ZDNet. “Then the IP address is removed from the data which is then archived. Mozilla does not create a profile of an individual over time.”

Suggested Tiles are currently active only in the EN-US version of Firefox, and the initial partners for the project—including Fortune Magazine, Quartz, the Make-a-Wish Foundation, and the Electronic Frontier Foundation—aren’t paying Mozilla for inclusion yet, so they’re marked “Suggested” rather than “Sponsored” for now. 🔌



IT'S IMPOSSIBLE
TO BEAT CANCER.

ALONE.



It takes all of us to beat cancer.
Doctors, researchers, volunteers,
and most importantly, people like
you. Join the movement to beat
cancer at StandUp2Cancer.org



♥ CVS Health

Welcome to Greenbot,
a website for
Android enthusiasts.



We've got the 'droid info you're looking for.
Helpful tips, critical reviews, and expert
analysis for passionate Android users
of every experience level.

www.greenbot.com



REVIEWS & RATINGS

CONTENTS

74 **Surface Book:**
Microsoft
reimagines the
laptop, and it's
glorious

96 **Microsoft Surface
Pro 4 review:** It's
faster, it's better,
and it has more
competition

111 **The iPad Pro vs.
the Surface Pro 3:**
We check Apple's
lofty performance
claims



Surface Book: Microsoft reimagines the laptop, and it's glorious

It's not hype. The Surface Book is powerful, fast, beautiful, and unlike any other laptop you've ever seen.

BY GORDON MAH UNG

YOU CAN SEE WHY Microsoft's Surface Book is ticking off other PC vendors (go.pcworld.com/pchostility). Microsoft's stunning laptop, gives you everything you want—showing up all the vendors who said it couldn't be done.

Our review bears that out. Want a true laptop experience that doesn't compromise? The Surface Book (go.pcworld.com/surfacebook) does it in an attention-catching fashion. Want to detach your monitor and use it as a gorgeous, perfectly proportioned tablet with pen support so beautiful it'll have you sobbing? The Surface Book does that, too. Stupid-long battery life? Yup.

And if you want a real graphics chip in an ultrathin chassis—something every other computer maker says couldn't be done—yeah, Surface Book's got that too.

In a word, *dayum*.

For this review, we had access to two Surface Books. The first featured an Intel dual-core Skylake Core i5-6300U, 8GB of LPDDR3 in dual-channel mode, and a 512GB M.2 PCIe SSD drive and integrated graphics only. The second Surface Book had the real deal: A dual-core Skylake Core i7-6600U, 16GB of LPDDR3 and the Nvidia graphics chip under the keyboard.

Dat hinge

Of course, the most striking feature of the Surface Book is its dynamic fulcrum hinge. It's a little reminiscent of the watchband hinge Lenovo uses on the just-announced Yoga 900 (go.pcworld.com/yoga900), but a lot beefier looking. Open the lid on the Surface Book, and the hinge unrolls. Microsoft says the unique mechanism allowed the company to balance the heavy display, which Microsoft calls the Clipboard, without upending the keyboard base. Other designs I've seen keep the laptop from flopping back on its head by tilting the keyboard up when open.



The hinge on the Surface Book isn't done for pure bling. Microsoft says it keeps the entire laptop from flopping over.



The hinge is fairly stiff. Trying to bend it without the Clipboard attached will take some strong hands. With the Clipboard attached, it's stiff enough that you can make fairly precise screen angle adjustments.

Microsoft calls this a Dynamic Fulcrum Hinge.

There is a little bit of screen flop that isn't present, on say, HP's Spectre X360, or Dell's XPS 13. But to be fair, the screen in this case is a lot heavier because it's a fully functioning computer.

Here's another difference: With other 2-in-1 detachables, you unhook the tablet from the keyboard with a plastic button or slider, and yank it off. With the Surface Book, you press a dedicated button on the keyboard for a few seconds. Inside the machine, you'll hear and feel a clunk, then you just lift it off.

Pieces of flair

Couldn't Microsoft have just used a conventional latch? Probably, but like the joke from *Office Space* goes, "People want atmosphere and attitude, that's what the pieces of flair are about." And the Muscle Wire Lock is definitely a piece of flair. It uses an electrically charged nickel titanium alloy wire called Nitinol that can change shape and then snap back based on the electricity applied to



This isn't just a polished logo. Microsoft machines or laser cuts this channel and then bonds four shined-up pieces of metal to make this logo.

it. The Muscle Wire Lock clamps tightly. Even trying to rip it off (and I tried) won't budge it.

There's also a little intelligence to it. With the Clipboard battery dead, I reattached it to the charged base unit. When I tried to remove it immediately afterward, the Surface Book pulled a HAL and wouldn't open the pod bay doors. Once the Clipboard had enough juice, a few minutes later, it relented. The Clipboard also won't flop off when the Surface Book's batteries are completely drained (I tried that too).

If you're thinking these are just nifty parlor tricks to dress up the same old laptop parts, hang on.



It's a good bet the GPU in the Surface Book is a variant of this chip.

The Surface Book's secret weapon

So you probably already know the Clipboard is a complete PC with a dual-core Skylake CPU, RAM, and storage inside (more on the particular specs later). Cramming all that into the thermal constraints of an 8mm-thick tablet is an engineering feat. But to get even more performance out of the Surface Book, Microsoft decided to embed a custom Nvidia GeForce GPU in the keyboard base. When docked, you get the power of a discrete GPU. When in Clipboard mode, you get



This is how the Surface Book's base connects power and graphics to the Clipboard section.

Intel's integrated graphics.

In another first, the Surface Book allows you to separate the Clipboard from the base while the device is still powered on and with the OS fully operational. Details of how Microsoft did this haven't been disclosed, but I've heard guesses from OEMs that point to everything from an internal Thunderbolt connection to some proprietary design.

My money's on something Ryan Smith at Anandtech.com mentioned: a little-noticed feature kicking around for years in Nvidia's Optimus. Optimus is used on most gaming laptops and allows a discrete GPU to run the show in games, or, say, Adobe Premiere Pro. But when in Word or other low-intensity applications, the power-hungry GPU kicks off and Intel's integrated graphics takes over to save power.

What most don't remember is that Optimus has supported the hot-swapping of GPUs since the beginning. In this demo on YouTube (go.pcworld.com/gpuswapvid) posted in 2010, Nvidia engineers even demonstrate how it would work.

A few vendors have implemented external graphics in a laptop, but no PC maker I know of has integrated the GPU into a separate part of the laptop. This approach is fairly ingenious, because it allows Microsoft to spread the hotter parts between the volume of both pieces.

We mixed peanut butter and chocolate

Microsoft's use of a GPU in the base unit also sets up some pretty interesting ramifications for how a laptop could be upgraded down the road. If you bought a Surface Book *without* the GPU, for instance, and somehow obtained a base unit *with* the GPU, marrying

Microsoft Surface Book

AT A GLANCE

Powerful, fast, and beautiful: The Surface Book is unlike any other laptop you've ever seen.

PROS

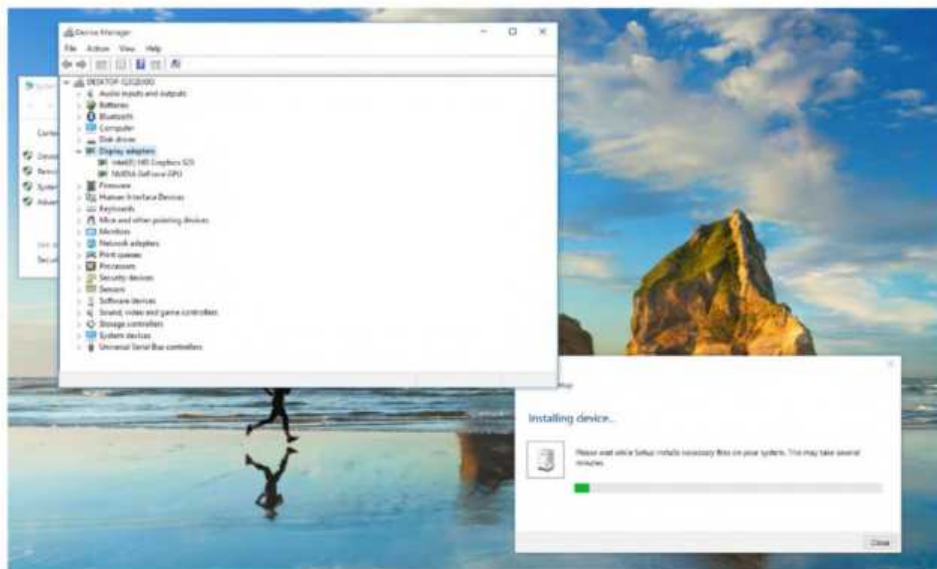
- Tremendous battery life
- Beautiful screen
- Doesn't compromise on laptop use and adds wonderful Clipboard mode

CONS

- Rather large and heavy
- Very expensive as you add on options.

\$1,700





the Clipboard to either base would work just fine, Microsoft says.

I tried it myself—yes, I got peanut butter in my chocolate. Did it work? Yup. After a few seconds of downloading drivers, it was up and running without even a need to reboot.

One important detail, should you want to try this “upgrade”: You’ll need the bigger power brick too. They may look the same, but the brick for the unit with discrete graphics puts out 60 watts, while the standard brick puts out just 31 watts. Charging with the lower-capacity brick will be slower, or you may find it discharging even when plugged in if the load is heavy enough.

Alas, the company has no plans to sell the base units with just the GPU. It’s an entire package or nothing.

Of course, that’s Microsoft’s position today, but I can see the potential to upgrade the graphics on the Surface Book by simply buying a new base unit with the latest GPU in it.

We plugged our Surface Book Clipboard without graphics onto the base with graphics and it worked.

As this is a Surface, there’s pen support of course

With Microsoft’s purchase of N-Trig over the summer, it’s no surprise

the Surface Book uses the same stylus technology as the Surface Pro 3. This time around, it's much improved, with pressure levels going from 256 in the Surface Pro 3 to 1,024 levels in the Surface Book and Surface Pro 4. There was a lot of griping from early Surface Pro users that losing the 1,024 in the original Pro was a step backward.

The Pen still uses a difficult-to-source AAAA part, but you shouldn't have to worry about it for a year or so between uses. Opening it is also a little different. With the Surface Pro 3 you just unscrewed the top. With the new Surface Pen, you rotate it counter-clockwise a few millimeters and then pull it out.

The good news is the new pen feels great. It features a rubbery nib with optional tips to tailor the feel. Microsoft said it also burned engineering time on a new G5 controller to optimize touch and pen input for the Surface.

I'm admittedly not a heavy pen-computing user, but I like one for those times when I need to sign or mark up a document. I compared the Surface Book's pen input to a laptop with a Synaptics pen, as well as the Surface Pro 3 with its older n-Trig pen. I found the palm rejection to be fairly excellent on the Surface Book, but it couldn't reject my knuckle-dragging ways. I like VAIO's solution: Just switch off the touch digitizer by pushing a button.

Parallax, which is certainly better on today's pen devices, was still a millimeter or so off from the tip of the pen when tilted over. Latency also didn't feel like a quantum leap over the Surface Pro 3 in my book, but I'm basing this on "feel" rather than any real testing.



The new Surface Pen has interchangeable nibs for a choice of writing or drawing feel.

Beautiful screen

The 13.5-inch screen on the Surface Book is a stunner. It's got a 3:2 aspect ratio with a resolution that's easy to do the math on: 3,000 x 2,000. That's about 6 megapixels.



Microsoft said it's an IPS panel that uses a "negative photo-aligned liquid oxide display." That's a fancy way of saying that during construction of the panels, the layers are carefully aligned to increase contrast and image quality. Televisions have used this technique, and Apple recently celebrated the tech in its iPhone 6 rollout. However, those layers make the screen more prone to reflections than, say, the current MacBook Pro 13.

The display is rated for 100 percent coverage of the sRGB color gamut. It's also spec'ed to hit a blazing 400 nits in brightness. Our meter agreed, putting our Surface Book sample actually a little brighter.

The screen is a 3,000 x 2,000 photo aligned IPS panel that'll hit 400 nits

Microsoft said it's an IPS panel that uses a 'negative photo-aligned liquid oxide display.'

Ports of call

The Surface Book's port array includes two USB 3.0 Type A, a miniDisplayPort, and an SD card reader. For an Ultrabook, this is pretty typical. The Surface Book gets bonus points for its docking station, which gives you two more DisplayPorts, Gigabit Ethernet, four USB 3.0 ports, and analog audio out. This all connects through the Surface power connector.



I'm surprised there's no support for Intel's new Thunderbolt 3.0 or USB 3.1 on the Surface Book for higher speed I/O devices. Sure, I'd rather have a pure miniDisplayPort over USB-C, but it feels odd not having USB 3.1, at least.

More about the GPU

Remember, we have two Surface Books. One has an Intel dual-core Skylake Core i5-6300U, 8GB of LPDDR3 in dual-channel mode, a 512GB M.2 PCIe SSD drive and integrated graphics only. The other boasts a dual-core Skylake Core i7-6600U, 16GB of LPDDR3, and the Nvidia graphics chip under the keyboard.

It's the dedicated graphics chip that gets us going. The specific model is unknown—all Microsoft would say publicly is it's a custom GeForce chip, and Nvidia won't say squat. Looking at the GPU in our Surface Book, I'm pretty certain it's a custom version of the GeForce 940m. It has 384 CUDA cores, runs at 945MHz, has 40GBps of memory bandwidth, and features a 64-wide memory bus. That sounds just like the GeForce 940m except for one thing: The chip in the Surface Book has 1GB of GDDR5, instead of the much slower DDR3 of most GeForce 940m laptops.

Here's a stack with the Dell XPS 13 on top, followed by an Apple MacBook Pro 2015, an HP Spectre X360, and then the Surface Book.



Watch the
video at
[go.pcworld.
com/surfacevid](https://go.pcworld.com/surfacevid)



There were a lot of forum groans when the chip's details surfaced, as some were expecting the GPU to be a higher-performing chip such as the GeForce GTX 950m. Unfortunately the laws of physics don't allow that today in a 13-inch laptop Ultrabook. If the custom GeForce chip in the Surface Book is indeed a GeForce 940m variant, it likely uses about 25 watts of power. Moving up to the GeForce GTX 950m would double your CUDA cores, memory bandwidth and probably the performance. It would also double the power consumption and heat. Today, that class of GPU is limited to larger and heavier laptops—nothing as lithe as the Surface Book.

We know a little more now about the plumbing, too. It's obviously an internal—umm, external PCIe connection that runs from the Clipboard to the Base unit. The connection is a x4 PCIe Gen 3 that offers about 25 percent the bandwidth of a full x16 PCIe Gen 3 connection. Some will recoil in horror, but it's plenty and shouldn't be an issue in the Surface Book.

CPU performance

Thanks to Skylake, both Surface Books performed well in our tests. As you may know, CPU clock speeds ramp up and down based on the load and how hot they get. With Intel's 5th-generation Broadwell chips, the CPUs would hit their higher Turbo Boost speeds and then, within a few minutes, fall back from, say, 2.9GHz to 2.6GHz. Skylake generally seems to hold much higher clock speeds even under heavy loads, at least on the early machines I've tested. Between the higher clock speeds and microarchitecture advances, it adds up to a meaty performance difference.

Encoding performance

In our Handbrake Encode test, we transcoded a 30GB 1080p file to the Android Tablet profile. It's a beefy test that has a CPU running at full load for almost two hours.

Both Surface Books turn in good scores here, but the edge for value goes to the Core i5 Surface Book. The Surface Book with the Core i7 CPU starts off at fairly high speed but settles down to about 2.95GHz for most of the run. The Surface Book with the Core i5 basically sits at

Nerds, I know

you want this, so here it is: A GPUz shot of the GeForce chip in the Surface Book.



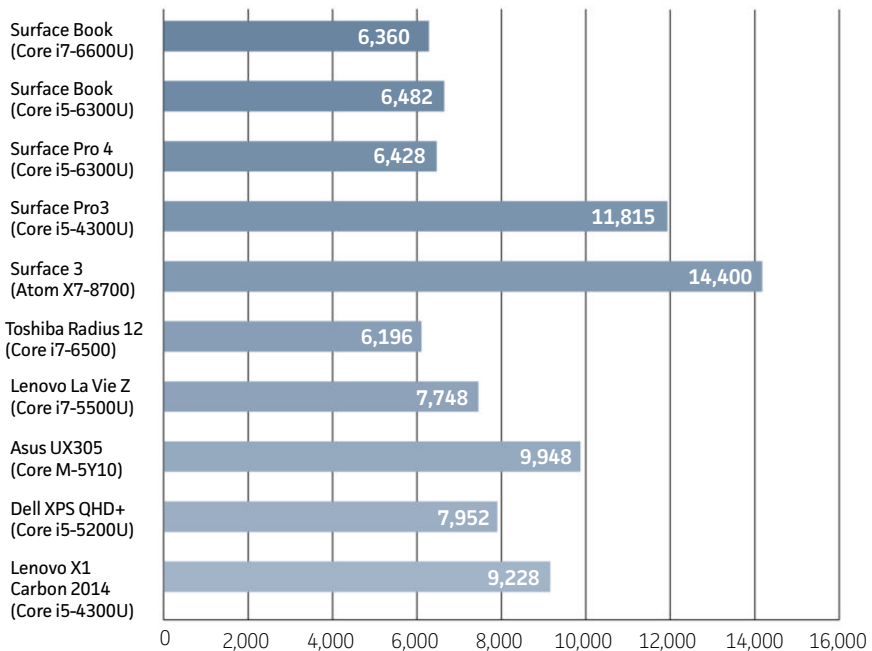
2.85GHz for most of its run. In the end, it's probably a wash.

One thing you should note: With the CPU sandwiched into a sub-8mm chassis with an LCD panel on top of it, Microsoft doesn't push the Core i7 in the Surface Book as hard as the Toshiba Radius 12 does. The Surface Book is actually a little slower than the Toshiba Radius 12.

If you're wondering why the Core i7 Surface Book is slower, you have to think like a manufacturer. How much heat can a PC really handle? How much fan noise are customers willing to tolerate? And what should be the maximum skin temperature of a laptop before users complain? Microsoft favors lower fan noise and skin temps, so it gives up a little performance on very long work loads.

On lengthy work loads, the Core i7 Surface Book doesn't yield as much advantage as you'd think over the Core i5 Surface Book, due to heat.

Handbrake Encode 0.9.9 (sec)



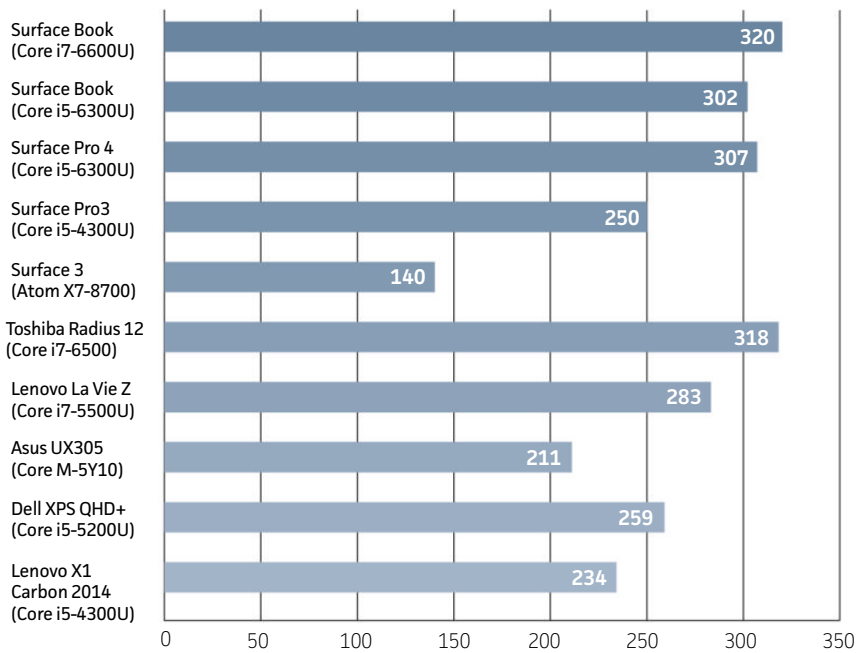
SHORTER BARS INDICATES BETTER PERFORMANCE

Cinebench performance

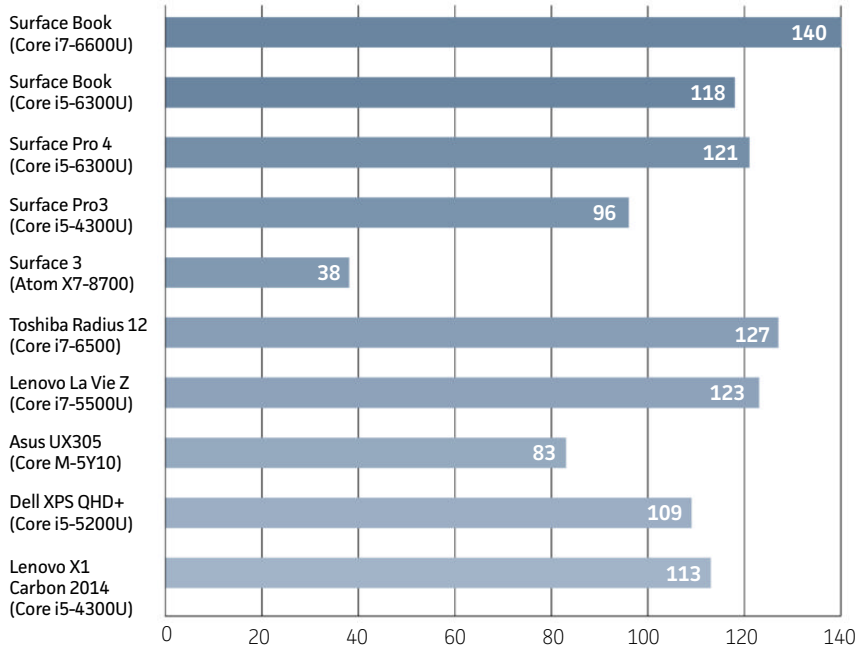
Moving on to Maxon's Cinebench R15, which measures a PC's performance in 3D rendering, I compared the same stack of Ultrabooks using various Haswell and Broadwell Core i5, Core i7 and Core M CPUs to again see the Surface Books outpacing the pack. The Core i5-6300U Surface Book even turns in a higher score than the Core i7-5500U in the Lenovo LaVie laptop. In the Surface Books, we see the Core i7 with a clear advantage over its sibling with the Core i5 as Cinebench takes only a few minutes to run.

In this 3D rendering benchmark, the Core i7-based Surface Book gets a little more breathing room.

CineBench R15 Multi-Threaded Performance



CineBench R15 Single-Threaded Performance



LONGER BARS INDICATES BETTER PERFORMANCE

Core i7 Surface Book is better in sprints

To put a finer point on it, I also ran Cinebench R15 in single-threaded mode. This would simulate CPU performance on most applications which don't actually use all of the cores. Here I expected to see the Surface Book open space between the Core i5 Surface Book and the Core i7 in the Toshiba Radius 12, and I wasn't disappointed. This basically tells you if your workloads are shorter and run in bursts, the Core i7 will yield better performance.

When limited to just CPU core and a lighter thermal load, you can see where the value of a Core i7 CPU in the Surface Book comes in.

Integrated graphics performance

Skylake's biggest performance benefit is obviously in graphics. All three of the Skylake-based machines in 3DMark Sky Diver show

sizeable performance boosts over the Haswell- and Broadwell-based devices. Between the Surface Book with the Core i5-6300U and the Dell XPS 13, you're looking at roughly a 32 percent difference. You may shrug at such an increase because it's just integrated graphics, but it's a significant performance upgrade to Broadwell.

Discrete graphics performance

Now we see if it was worth Microsoft's trouble to get that chip into an Ultrabook. First up is the obligatory benchmark chart with the Surface Book and discrete graphics chip added into the mix. Bam. Yes, the discrete chip in the Surface Book pile drives the entire room of integrated graphics laptops it's compared to. Against the Surface Book without discrete graphics, it's about a 50 percent performance advantage. Against the Dell XPS 13 with its HD 5500, the gap opens up to 80 percent.

But let's face reality: The GPU in the Surface Book does not put it in contention with an 8-pound, 17-inch gaming laptop or even a mid-range, five-pound laptop.

That doesn't mean you can't game on the Surface Book. *Counter-Strike: Global Operations*, *DOTA*, *League of Legends*, and *StarCraft II* are not a problem. They're barely a problem for the latest integrated graphics, also, but the Surface Book will give you twice the performance of integrated graphics in those games and more.

For example, *Tomb Raider* at normal is fully playable and quite smooth at 71 fps on the Surface Book at 1,280 x 1,024. *DiRT Rally* can be run at ever-high settings with the same resolution compromise. It's honestly acceptable gaming if you have tempered expectations and



In the Surface Books, we see the Core i7 with a clear advantage over its sibling with the Core i5.

accept that this is a GeForce 940m-class GPU, not a GeForce GTX 980. Why don't I have scores for the other Ultrabooks in these games? I frankly don't try to run them on integrated graphics.

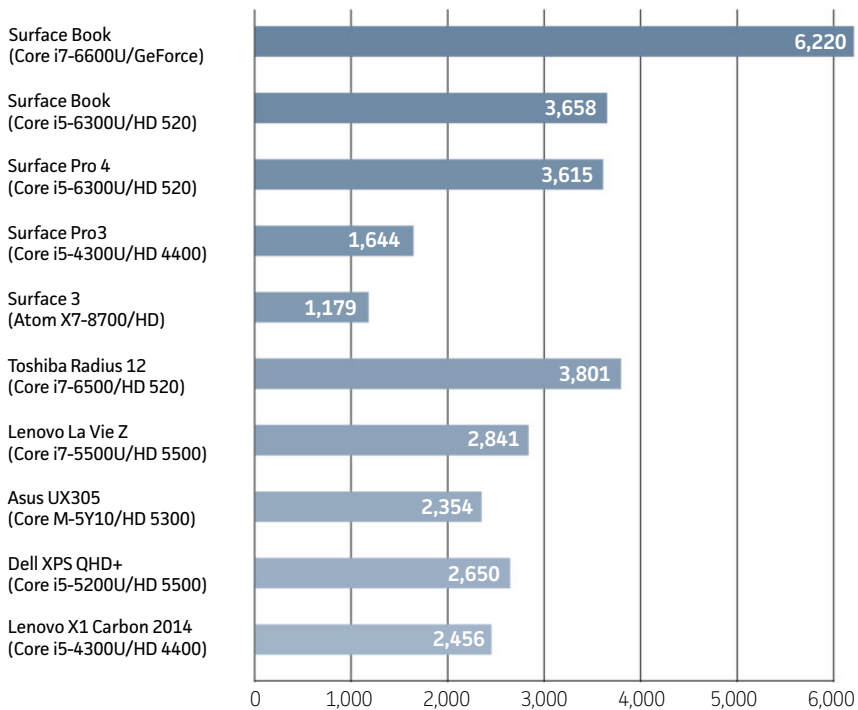
All that said, Intel still has a card to play with its upcoming Iris and Iris Pro graphics cores. They may really change the equation of this battle.

Discrete graphics are more for pros

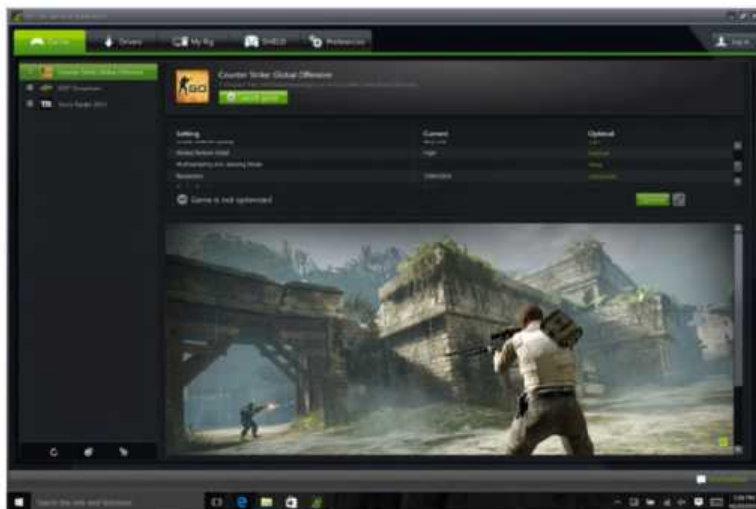
The discrete graphics gambit for the Surface Book is not just about gaming. It's really to cater to the person who needs CAD/CAM or other apps. In an encode job I threw at both the Surface Book with

You can easily
see the
performance of
the GPU in the
Surface Book
over Intel's
Skylake,
Broadwell, and
Haswell
graphics.

3DMark Sky Diver Overall



LONGER BARS INDICATES BETTER PERFORMANCE



Yes, GeForce Experience does indeed work on the Surface Book. It just isn't installed from the factory.

the Nvidia GPU and a current-generation MacBook Pro 13, I saw a better than 50 percent performance advantage for the Surface Book.

Drivers and GeForce Experience

PC gamers cherish their drivers as much as their GPU. In most gaming laptops, you download drivers directly from Nvidia or AMD. For the Surface Book, Microsoft says it will vet and push out drivers directly but you can probably run reference drivers as well.

I installed GeForce Experience on my Surface Book with GeForce graphics, and it appears to work fine for optimizing games at this point.

Stupid-long battery life? Yes.

Besides Microsoft's audacious performance claims, the company also promises outstanding battery life and up to 12 hours of video run time. Your mileage will vary, of course. What you're testing and screen brightness has a huge effect on battery life.

As Microsoft didn't provide details on the video run-down tests, I used our old standby MobileMark 2014 to measure battery life. It uses

industry-standard applications such as Word, PowerPoint, Chrome and Acrobat to measure realistic run times. Some have accused Mobile Mark of being too much of a “best case scenario” for battery life, but it’s hard to argue with the methodology. No one actually sits at his or her laptop for 8 hours straight and works on a plane. You take breaks, flip through the free Skymall magazine (may it rest in peace), and then you get back to work. MobileMark 2014 simulates this scenario, including blanking out the screen for minutes at a time.

It’s like a gas tank

With a laptop, the battery size is similar to the gas tank in your car. The typical Ultrabook will feature a 42-watt-hour or maybe 52-watt-hour battery pack.

In the Surface Books, the base unit has a 51-watt-hour capacity, with another 18 watt hours of cell in the Clipboard. In our test of the Core i5 unit without discrete graphics (the same configuration Microsoft uses for its 12-hour promise), we actually saw *longer* run times. Why? Video uses more power as it’s usually run with a brighter screen, constant sound and it doesn’t ever blank the screen. If you really want to go down the rabbit hole on battery life, read this (go.pcworld.com/batterylife).

Our Core i5 Surface Book gave us a stupendous 821 minutes, or almost 13.6 hours of runtime. That’s the longest I’ve ever seen out of a Ultrabook with a 13-inch screen.

I also tested the Surface Book in Clipboard mode to see how long it would run away from its base. As the Clipboard has roughly 25 percent of the battery capacity, I saw roughly 25 percent of the battery life, or 209 minutes.



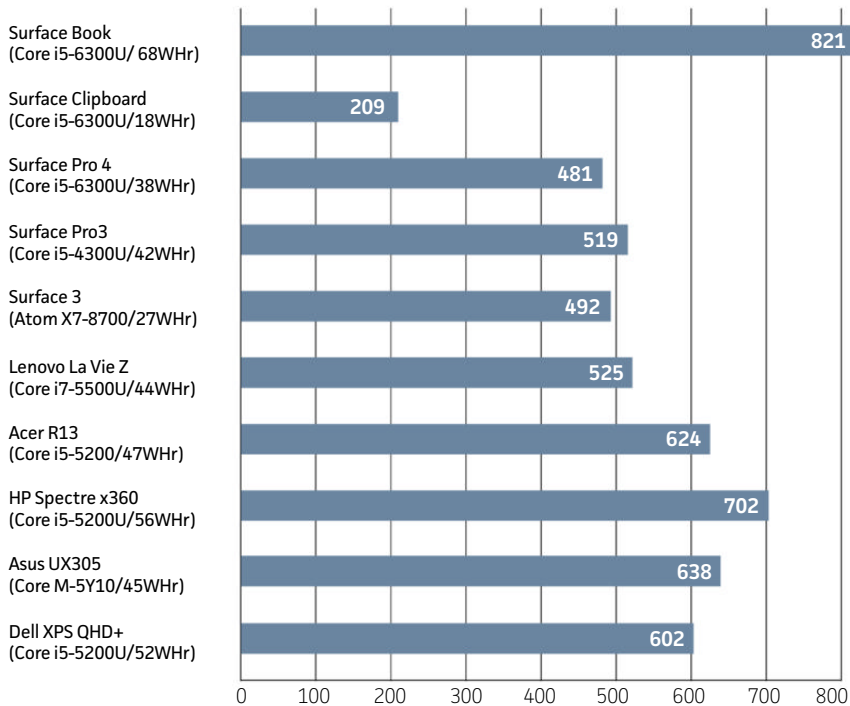
The Surface Book isn’t the “ultimate laptop” because it’s more than a laptop.

Again, increasing the brightness of the screen or doing a CPU- or GPU-intensive chore will drain the battery faster, but overall, the Surface Book will give you stupendous battery life.

How does that apply to the Surface Book with discrete GPU? That depends. Assuming the graphics chip powers down when not in use (how else could you disconnect it?), you should see minimal impact. Once you spool up that GPU with its 25 watts of power draw, expect the battery to head toward empty really fast. If you're working on your company's TPS reports on that trans-pacific flight, you should be fine

The Surface Book's massive battery capacity puts it well ahead of the pack.

Mobile Mark 2014 Office Productivity Battery Life (min)



LONGER BARS INDICATES BETTER PERFORMANCE

on battery life the whole time. But if you decide to play a graphically-intensive game or edit video, you better bring a Kindle paperwhite with you for entertainment after the battery runs dry, because it definitely won't last for 12 hours. .

TrackPad and Keyboard

The trackpad is a spacious Precision model that's quite luxurious. The entire trackpad is physically clickable. It feels like a standard hinge design that takes more pressure to click the trackpad near the top than near the bottom where you have more leverage. I'm not a total fan because the texture seemed to let my finger drag, but this is personal preference and enough Doritos grease will fix it.

The keyboard, I have no complaints about. The keys feature a standard 19mm pitch with a full 1.6mm of travel. If I had to nitpick, it would be the cursor keys which stack the up and down buttons.

There's one issue I've had occur a couple of times on both units: The trackpad in the Base loses sync with the Clipboard, requiring a detach cycle to re-enable. Microsoft officials said they're aware of the problem, and expect to fix it soon.

Size and weight

Take the Surface Book and plop Dell's XPS 13 next to it, and you'll understand just how big of a footprint the Book has. Let's just say it isn't tiny with its 13.5-inch screen. There are bigger laptops in its class, though. HP's Spectre X360 is wider than the Surface Book and Lenovo's Yoga 2 Pro takes up even more space.

It's no featherweight Lenovo LaVie Z, either. I weighed both iterations of the Surface Book I had on our calibrated Pitney Bowes

Our Core i5 Surface Book gave us a stupendous 821 minutes, or almost 13.6 hours of runtime.



postal scale, and both are definitely in the heavier range.

Price and value

The Surface Book is a premium device, and it's priced accordingly. For comparison, you can get a Dell XPS 13 with a Skylake Core i5, 256GB SSD, touch screen and SSD, Core i5 processor, QHD+ screen and touch for \$1,450. If you spent \$1,500 on an HP Spectre X360, you get a Core i7 chip, touch screen, QHD display, 8GB of RAM and a 512GB SSD.

The base Surface Book gives you 8GB of RAM, a Core i5 and a 128GB SSD, and that's without the GeForce graphics. The cheapest Core i5 Surface Book with the GeForce chip is \$1,900, but at least it bumps storage to 256GB.

Fully kitted out with a Core i7, 16GB of RAM GeForce graphics and 1TB SSD, and you're pushing \$3,200.

Determining value gets murky because you have to consider all the extra little features that the Surface Book offers. None of those other laptops offer a detachable screen, nor discrete graphics options. So if those are truly features you need, then yes, the value is there. But there's no way around it: The Surface Book is expensive.

Bottom line

During Microsoft's unveil of the Surface Book, two things caught my attention: The first was calling it the "ultimate laptop." The second was saying no laptop in its class would be faster.

Both are incredibly bold statements that would normally be dismissed as marketing hyperbole.

On the second point—that no other 13-inch Ultrabook laptop is faster—I can confirm that, with qualifications.

Yes, the Surface Book with discrete graphics just can't be touched by



any other modern 13-inch Ultrabook in graphically intense chores. In CPU chores it gives as much as it gets from competing designs. It is truly the fastest laptop in its class.

But is it really the “ultimate” laptop? There I’d disagree, because the Surface Book is actually more than one of the best laptops out today. You effortlessly detach that gorgeous display for a large tablet experience that no other laptop can give you. That truly is something. 🔌



This gives an idea of the footprint of the Surface Book. The top left is HP’s Spectre X360. On the top right, the Surface Book. The bottom left is Dell’s XPS 13, and on the bottom right is an Apple MacBook Pro 13 2015.

Microsoft Surface Pro 4 review: It's faster, it's better, and it has more competition

Microsoft's Surface Pro 4 improves inside and out, but new Windows tablets are lurking in the wings. Can it keep its 'best-of' crown? We'll see.

BY MARK HACHMAN



Watch the
video at
go.pcworld.com/surfacepro4vidrv

IDG.tv

THE MICROSOFT SURFACE Pro 4 (SP4) has satisfied one expectation: It's taken the proven success of the Surface Pro 3 (SP3) and gone even further, offering a substantial performance boost and other improvements.

Now comes the harder part. The tablet ecosystem has dramatically evolved since the launch of the Surface Pro 3. New Surface clones like the Lenovo Miix 700 (go.pcworld.com/miix700) and the Vaio Canvas (go.pcworld.com/vaiozcanvas) will ship soon. Then there's the Surface Pro 4's flashy new family member: the Surface Book, a two-in-one boasting incredible battery life and a pricey external GPU option. Suddenly the Surface Pro 4 is simply *machina sapiena*, and the Book is *machina maxima*.

The Surface Pro 4 (go.pcworld.com/surfacepro4) may have to resign itself to living in the shadow of the Surface Book. As for the rest of the new competition, the Surface Pro 4's impressive features, performance, and overall experience have set some tough new standards for high-end Windows tablets. We'll see if any of them can meet the challenge.

Subtle changes outside, big changes inside

You'd be forgiven for mistaking the Surface Pro 4 for the Surface Pro 3 at a glance—the two generations of Microsoft tablet are nearly a mirror image of one another. At 11.5 by 7.93 by 0.33 inches, the Surface Pro 4 is a mere 0.03 inch thinner than the SP3, and at 1.73 pounds, just 0.03 pound lighter.

Look closer, and you'll see Microsoft trimmed the bezel and bumped up the display size from 12

Microsoft Surface Pro 4

AT A GLANCE

The combination of an Intel Skylake chip, a new Type Cover keyboard, and faster SSD speed help push the Surface Pro 4 into a higher echelon of performance.

PROS

- New Intel Skylake processor dramatically increases performance
- Redesigned Type Cover more closely approximates laptop keyboard
- New Surface Dock is now semi-portable

CONS

- Battery life is slightly lower than Surface Pro 3
- New Surface Pen tends to slide off tablet
- The “curse of the missing cursor” still rears its head occasionally

\$1,300



inches and 2160 x 1440 pixels on the Surface Pro 3, to 12.3 inches and 2736 x 1824 pixels on the SP4's display. (The additional pixels, though, were just enough that I had to bump up the text size to 175 percent, rather than the default suggestion of 150 percent.) Likewise, Microsoft gave the keys on the new Type Cover keyboard a bit more breathing room compared to the tight clump on the SP3's Type Cover.

This time around, what sells the Surface Pro 4 is on the inside: a sixth-generation Intel Skylake processor that kicks up 3D performance by as much as 81 percent.

Microsoft also re-engineered the Surface Pro 4 to distribute heat throughout the top portion of the rear panel, eliminating hot spots and allowing the optional Core i5 and Core i7 chips inside to run at full speed—something the SP3 couldn't do.

And, of course, there's the price. The Surface Pro 3 offered an \$800 Core i3 starter option, but the Core m-based Surface Pro 4 starts at \$899. The SP4 Microsoft gave us to test carries an Intel Core i5 with

This time around, what sells the Surface Pro 4 is on the inside: a sixth-generation Intel Skylake processor that kicks up 3D performance by as much as 81 percent.



The Surface Pro 3 (left) and the new Microsoft Surface Pro 4.



The Surface Pro 4's

kickstand is easier to swing out, but otherwise remains the same.

8GB of RAM and a 256GB SSD, a \$1,299 tablet. You'll pay up to \$1,599 for the highest-end Core i7 version. Note that the Type Cover keyboard will cost an additional \$130 even though we'd consider it an essential accessory. Microsoft hasn't said anything about integrating the Surface Pro 4 with an LTE option, but we'd expect that to happen eventually.

Otherwise, the Surface Pro 4 should feel comfortably familiar. You'll still need to find the power button (top left, next to the volume rocker, like on the SP3) and there's the standard single USB 3.0 port, miniDisplayPort connector, and microSD card reader. The Surface Pro 4 integrates 802.11ac Wi-Fi, same as its predecessor, as well as Bluetooth 4.0.

The slightly wider form factor means that the SP4 won't work with the Surface Pro 3's dock, but the charger appears to be identical. (Note while the Surface Pro 4 connector is identical to the Surface Pro 3's, the Dock's Surface connector is chunkier.)

The kickstand remains almost the same: On the SP3, it swings out easily about 30 degrees into "stage mode," then more slowly back until it reaches the maximum 150 degrees. On the SP4, there's just a fluid range of motion from 0 to 150 degrees. That's not necessarily an advantage; the stiffer SP3 hinge holds the tablet solidly in place, while you may nudge the SP4 out of position if you're constantly jabbing at the screen. Still, it's easier to get the tablet angled to where you want it. Both tablets feel about the same in your lap.

Welcome to the world of Windows 10

Windows 10 may have been officially released months ago, but the Surface Pro 4 is one of the first machines to include it from the get-go.

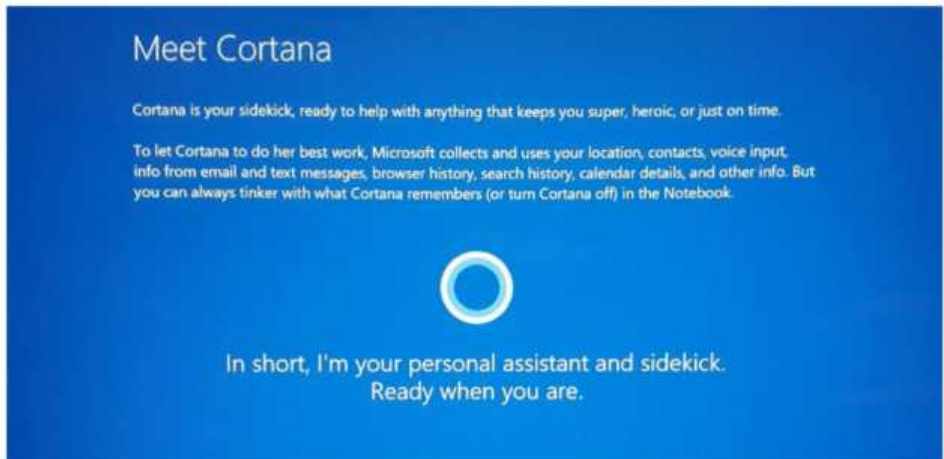
Both the Surface Pro 4 and the Surface Book feature a new set of Surface-specific setup screens that serve as a useful introduction to two new features: Microsoft's digital assistant, Cortana, as well as the new Surface Pen (which we'll discuss more later). This accomplishes two things: first, it ensures you'll hit the ground running. And by waiving (or not) all the privacy concerns associated with Cortana before you actually use it, you slide gently into Microsoft's world.

And it's a pretty nice world.

The inclusion of Windows 10 means that the Surface Pro 4 doesn't need the dedicated Windows hardware button, and can instead use the soft Windows button on the screen that launches the Start menu.



The Surface Pro 4 setup includes a Pen walkthrough.



You're hustled through the Cortana privacy agreement, too.

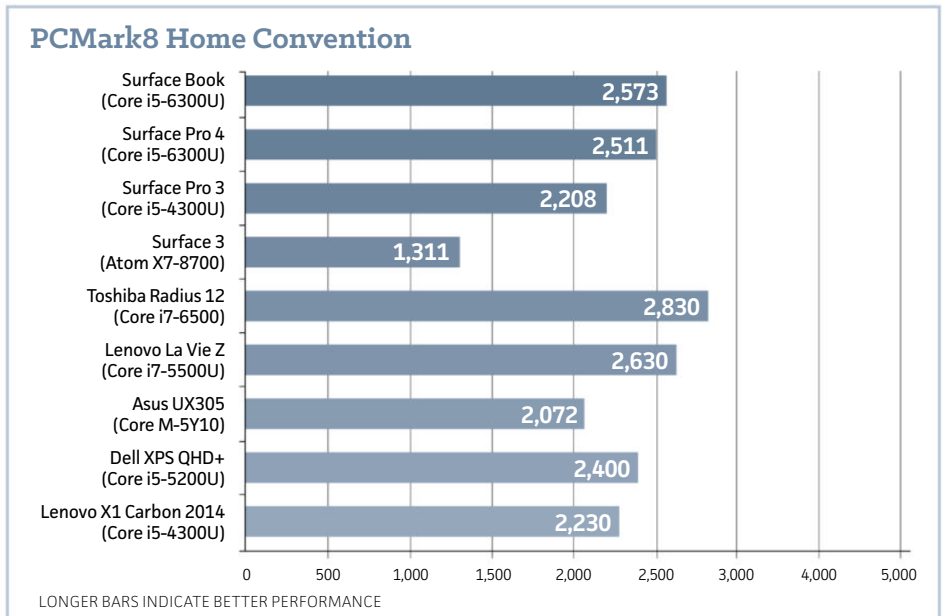
Packed with power

Without a doubt, the primary reason to buy a Surface Pro 4 is its dramatic boost in performance relative to the Surface Pro 3.

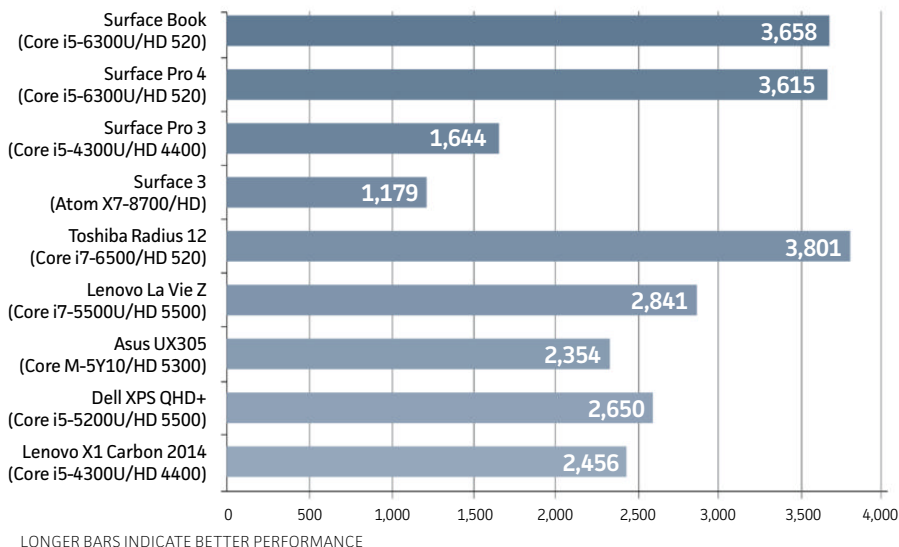
You won't see the benefit in mainstream productivity, as evidenced by the mere 6-percent uptick in the

You won't see the benefit in mainstream productivity, as evidenced by the mere 6-percent uptick in the PCMark Home Conventional test at native resolutions

PCMark Home Conventional test at native resolutions, or the slight 3-percent drop in PCMark Work Conventional performance. Our Surface Pro 3 contains a 1.9GHz Core i5-4300 Haswell chip and 8GB of RAM; the Surface Pro 4 includes a 2.4GHz Core i5-6300U Skylake chip and 8GB of RAM. Remember, the SP4 is also pushing a few more pixels.



3DMark Sky Diver Overall



But what we did measure was a 32-percent increase in the 3Dmark Sky Diver benchmark, and a 36-percent boost in the Cloud Gate benchmark. When we forced the Surface Pro 3 to throttle itself, the performance gap leapt upward to the 81 percent we cited earlier.

In part, this is due to improved liquid cooling system in the Surface Pro 4. With the SP3, heat collected in a spot on the rear of the machine, causing the fan to rev up and the SP3 to limit its CPU speed in an attempt to prevent overheating. New cooling pipes in the Surface Pro 4 route heat across most of the rear panel. This causes the rear panel to warm as a whole, but prevents the need to run the fan.

If the Surface Pro 4 suffered from the same thermal issues as the SP3, you'd see it in this prolonged Handbrake media encoding test—and you don't.

But what we did measure was a 32 percent increase in the 3Dmark Sky Diver benchmark.

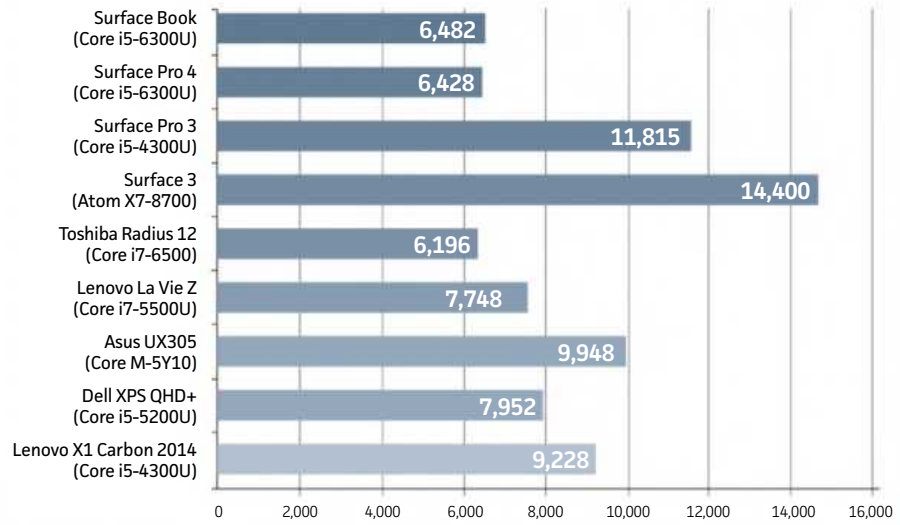
What that means, of course, is that you won't notice any difference in how your Surface runs Office. But any applications that make heavy use of the CPU as well as the integrated graphics will demonstrate improved performance, from light gaming to simple Web browsing, 3D applications and more.

And yes, you can play games: I eked out 34 frames per second on Crysis 2 (1280x720, High settings, DX11 off); 30 frames per second on Dishonored (1600x1200), but only 25 frames per second on Batman:



Here's how the Surface Pro 4 dissipates heat under the hood.

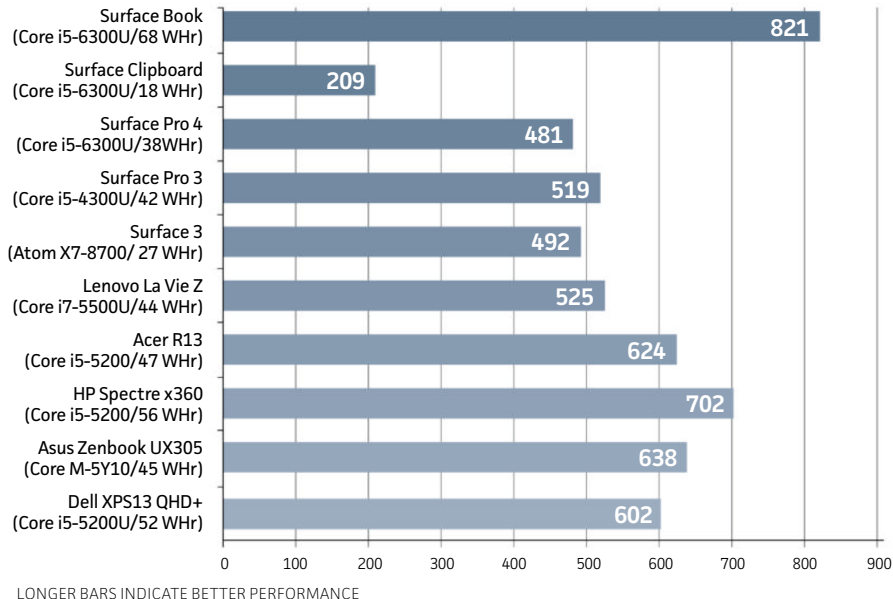
Handbrake Encode 0.9.9 (sec)



SHORTER BARS INDICATE BETTER PERFORMANCE

If the Surface Pro 4 suffered from the same thermal issues as the SP3, you'd see it in this prolonged Handbrake media encoding test—and you don't.

Mobile Mark 2014 Office Productivity Battery Life (min)



Arkham Origins (1024x768, all options off). If you're the type of person who doesn't mind playing older games on the cheap, the Surface Pro 4 suffices.

The disappointment here is battery life:

The Surface Pro 4 is dramatically faster in disk speed, as well. Both of our Surface Pro 3 and Surface Pro 4 test machines include 256GB SSDs. The Toshiba device in the SP4 reported a CrystalMark 5 read score of 1578MB/s and a write score of 311MB/s; that's roughly three times the read speed of the Surface Pro 3's drive (552MB/s read, 136MB/s write).

The disappointment here is battery life: Using the standard MobileMark 2014 test that measures normal Office use, we recorded about 481 minutes (8 hours, 1 minute), versus 519 minutes with the SP3. We haven't tested the Core m3-based Surface Pro 4, but it should offer longer battery life—and lesser performance, of course.



A refined Type Cover, but a step back for Surface Pen

I've used the Surface Pro 3 for eighteen months or so, mostly as a daily driver, so my fingers have grown quite used to the Surface Pro 3's Type Cover. While it doesn't quite boast the rigidity of a laptop's keyboard, I'd say the Surface Pro 3's Type Cover comes pretty close.

What's most notable about the Surface Pro 4's keyboard is that the keys are smaller—about 16mm square, as opposed to 18mm for the SP3—but spaced more widely, about 3mm apart, whereas the SP3's keys almost bump up against one another. All told, the SP4's key pitch is a more spacious 19mm, with 1.3mm of travel.

Although the SP4 keys feel slightly stiffer, I was able to type comfortably. Based on the light that leaks from behind the SP4 Type Cover's keys, I suspect I'll have to be careful about dropping crumbs during a working lunch. What's interesting, though, is that the SP4's spacebar seems to be almost sealed, while the other keys have more noticeable gaps.

You can use your older SP3 Type Cover with the new Surface Pro 4, saving yourself \$130.

The Surface Pro 4's Type Cover features backlit keys that are spaced out a bit.

The trackpad is wider and smoother, about 30 percent larger than the SP3's. And it's smooth—your finger easily glides right over it, like a gaming mousepad.

I confess that I'm not as much of a fan of the revised Surface Pen, which magnetically clamps to the side of the Surface Pro 4 tablet. Say what you will about the SP3's Pen—but that fabric loop meant that thing wasn't going anywhere. With the SP4, you may find that the Pen slides off and disappears into your backpack every so often—although carrying the SP4 with the Pen at the top helps, too. I still think inserting the pen into the chassis, as the Samsung Galaxy Note series does, is the way to go.

The Surface Pen has quietly evolved into a fourth input device for the Surface line, beyond trackpad, keyboard, and touchscreen. There are some features I really like: For one thing, simply flipping it upside down and sliding it across the screen erases what you've written, like—well, an eraser. Clicking the top of the Pen launches OneNote, clicking it twice saves a screenshot. Clicking and holding launches Cortana's oral search—which is really quite handy while in tablet mode.

But something about the Surface Pro 3's Pen resonates with me a bit more, especially when writing. Microsoft's new SP4 boasts a technology called PixelSense, which helps reject your hand when inking. That worked flawlessly—but, then again, I haven't had many problems with the Surface 3 or Surface Pro 3's pen, either. And maybe



The Microsoft Surface Pro 4 also boasts a larger trackpad, but solid palm rejection means you don't have to worry about where you place your hands.



A strong magnet grips the new Surface Pen and holds it to the side of the Surface Pro 4 tablet.

it's the way I scrawl notes, but the Surface Pro 4's stylus just didn't feel as comfortable on the glass as the SP3. Some people won't like how the SP4 eliminates the right-click button from the Pen, either.

Can you use your older SP3 Pen on the new Surface Pro 4? Well, not really. My SP3's Pen wrote on the Surface Pro 4, but that's about it. I suspect that the SP3's Surface app (go.pcworld.com/sp3app) may be updated to allow the SP3 Pen to launch Cortana, however.

Both stylies still leave a trail of e-ink that lags behind the stylus when making broad, sweeping strokes. Still, if you didn't like how pressure distorted the SP3's display, you'll be happy to know that's vanished from the SP4.

The Surface Pen's battery is replaceable, and you won't have to replace the battery when it expires, in what Microsoft says will be a year's time. It doesn't unscrew like the SP3 Pen does, but the cap does slide off. Microsoft also sells a \$10 pen-tip kit which may very well provide a more comfortable solution than what the Pen offers, but I didn't have a chance to try it.

One more note on productivity: the Surface Pro 4 boasts an 8MP autofocus rear camera, up from a 5MP camera on the SP3. (Both have a 5MP front-facing camera as well.) I often evangelize the use of OneNote to take notes, and I envision the new Surface Pro 4's being used to record a video record of an academic lecture. Think about it: If you're perched in a lecture hall, you're tilting your tablet down anyway. That camera's already in position to record a video of the lecture to accompany your notes!

The front-facing camera doubles as a depth camera enabling Windows Hello, Microsoft's biometric login solution. But Microsoft won't enable it until sometime soon after the launch, when it will push an update that will turn it on. Microsoft will also ship a \$160 Type Cover with an integrated fingerprint reader by Oct. 26.



**Simply
"drawing"**
on the screen
with the top of
the Surface
Pen erases your
digital ink.

The new Dock poses a convenience conundrum

There was something predatory in the way in which the mandibles of the original Surface docks clamped the tablet, holding it fast. The new Dock is far more deferential.

This time around, what Microsoft calls the Surface Dock is a power brick. And that's fairly close to the truth: Compare the dock's actual power brick to the dock itself—Microsoft carved them out of identical hunks of plastic.



Functionally, however, the dock is an upgrade to the previous docks: There are four USB 3.0 connections, and not one but two miniDisplayPort connections, plus Gigabit Ethernet and a Kensington lock. (You can still use the tablet's existing USB port, as well.) It's all routed through a sturdier Surface connector, which snakes from the Dock to the tablet via a short length of cable.

The real advantage here is that the new Dock permits the SP4 to recline to any position, while the earlier docks locked it into a single position. I like that. It doesn't seem to work with the SP3, though—I was able to power the SP3 via the dock, but when I attached a mouse and keyboard, they didn't work.

About the only concern I have with this is that the Dock is small enough to fit in a backpack or carry-on—which means you have a decision to make. Do you tote along the combined 2.5 pounds of the Dock and its power brick, or leave it at home? Remember, that's significantly more than the 1.73 pounds the tablet itself weighs. (The Type Cover is about 0.63 pound, for a total weight of 2.36 pounds.)

Can't decide? Then consider this: The eTauro dock (go.pcworld.com/etauros) we reviewed earlier is cheaper, lighter, and nearly as

The Death Star: the Surface Pro 3 dock.



The new Surface Dock is literally the size and shape of its own power brick.

effective as the \$200 Surface Dock, though it lacks an Ethernet jack.

I'm disappointed to see that one Surface bug hasn't disappeared: the tendency of the SP4 to suddenly lose the cursor, or for the trackpad and keyboard to stop working. This occasionally happens, and disconnecting and reconnecting the keyboard usually solves the problem. Occasionally, however, it requires a reboot.

What to buy? You can't go wrong with Surface Pro 4.

So far we've considered the Surface Pro 4 in a vacuum of sorts, compared to the Surface Pro 3. For its part, Microsoft took pains to compare the SP4 and Surface Book to Apple hardware like the MacBook Pro and iPad. I reject that comparison. If you want an iPad, buy an iPad. Windows, iOS, and Mac OS are different animals, and should be treated as such.

A better comparison would be between the SP4 and the emerging class of Surface clones, like the Lenovo Miix 700 and the Vaio Canvas.

And then there's the other question: Should you buy the Surface Pro 4, or the Book? Microsoft makes the question a simple one. Compared to a Core i5-based SP4, you can pay an additional \$400 more for what the Book offers: four more hours of battery life as well as a laptop-like experience. The difference between a Core i7-based SP4 and a comparable Book with a discrete graphics chip, meanwhile, is about \$600. Yes, I covet the additional battery life of the Book, if only

because I'm paranoid about running out of battery when I need it most. But oh, that price!

Any review score is a snapshot in time, but that's particularly true for the Surface Pro 4. It's clearly a much better tablet than its predecessor, because the compelling performance increase overcomes the shortcomings of the Pen and the mediocre battery life. But will it prove to be the best-in-class of this new category of Surface clones? We don't know yet. But if the up-and-comers prove to be competitive with the Surface Pro 4, that'd actually be great news for the Windows ecosystem. 🔌



The new Surface Dock (right) sits next to its power brick (left).



The iPad Pro vs. the Surface Pro 3: We check Apple's lofty performance claims

BY GORDON MAH

THE IPAD PRO will offer “desktop-class performance” and have a CPU faster than 80 percent of portable PCs shipped.

If you just fell off your chair, it's understandable. Those claims made by Apple about its newest tablet are truly bold. They're also pretty hard to believe for anyone who believes in the inarguable performance supremacy of the PC and x86 over tablets and ARM.

Let's take a closer look at exactly what Apple's VP of marketing Phil Schiller said about the iPad Pro (go.pcworld.com/ipadprofaq)

during the company's big unveil September 9. During his talk, Schiller said the new 64-bit A9X SoC doubled memory bandwidth, doubled storage read and storage, and offered 1.9X the performance of the iPad Air 2.

"This is desktop-class performance," Schiller boasted. "It is faster than 80 percent of the portable PCs that shipped in the last 12 months, that's at CPU tasks. At graphics tasks, it's faster than 90 percent of them."

Schiller did seem to qualify the statements that the GPU performance really sang using Apple's new Metal but didn't specifically say Metal support was required to be "better than 90 percent" of portable PCs.

He continued to say: "When you run tasks and applications that we all love to use, they get incredibly fast. For example, running iMovie on an iPad Pro delivers desktop-class performance. With iMovie you can now edit three streams of 4K video simultaneously."

Schiller also demonstrated AutoCAD 360, showing wireframe mesh with 320,000 objects and saying: "That's something you can't do on the PC."

Editor's note: This article was published before Microsoft announced the Surface Pro 4 on October 6; however, it still provides a useful point of reference as we prepare to test the new tablet. Stay tuned for more benchmarks.

What does this even mean?

Faster than 80%
of portable PCs



Shades of the snail

When I heard Schiller's claims, it reminded me of one of Apple's previous claims: that the PowerPC G3-based Mac made a monkey out of the PC. Citing results from the now-defunct magazine *Byte*, Apple said the new Macintosh was twice as fast as a 350MHz Pentium II. The truth, of course, was quite different. Even some Macintosh partisan magazines of the era agreed that at best, it was maybe 19 percent faster in Photoshop and other real-world applications and got as good as it gave against a Pentium II chip. That didn't stop Apple from picking fights with Intel: One of its more memorable ads showed a garden snail crawling along with a Pentium II on its back.

What exactly is "80 percent of portable PCs?"

The problem with Apple's claims is the lack of detail. What did Schiller mean by "Portable PC?" Does that figure include Atom-based tablets? Does it include Chromebooks? Does it count Macbooks? I reached out to Apple for clarification. A few days on, I still haven't heard back, and I suspect I won't.

I decided to approach it from another angle and figure out what 80 percent of the portable PC market looks like today. Neither Intel nor AMD disclose that kind of granularity to the public, so I spoke with analyst Dean McCarron of Mercury Research. McCarron closely follows



Years ago, Apple proudly proclaimed the PowerPC G3 chip far faster than Intel's Pentium II. The truth, besides a few cherry-picked tests, was quite the opposite though.

Does that figure
include Atom-
based tablets?
Does it include
Chromebooks?
Does it count
Macbooks?

the chip market using public and private data civilians can't access.

He said if you exclude Atom and count only Core i3, Pentium and Celeron, plus some of the Core i5 CPUs, and then lump in AMD APUs, you get pretty close to 75 percent sold, which is pretty close to Apple's 80 percent number.

"I can't speak for Apple, but if they're saying faster than 80 percent of notebook PCs in the past 12 months, it would have to compete with Haswell dual-core pretty far up the Haswell product stack—not all the way, but at least past most i3s and some i5," McCarron said. "Again, they're in control of their own metrics for measurements, and it's pretty much the industry norm to pick ones that show your product most favorably."

Because Intel moves the most laptop chips, I'm pretty certain Apple feels the iPad Pro stands up even to Intel's Haswell and Broadwell CPUs. The A8X is already generally faster than the bulk of the Atom-based chips.

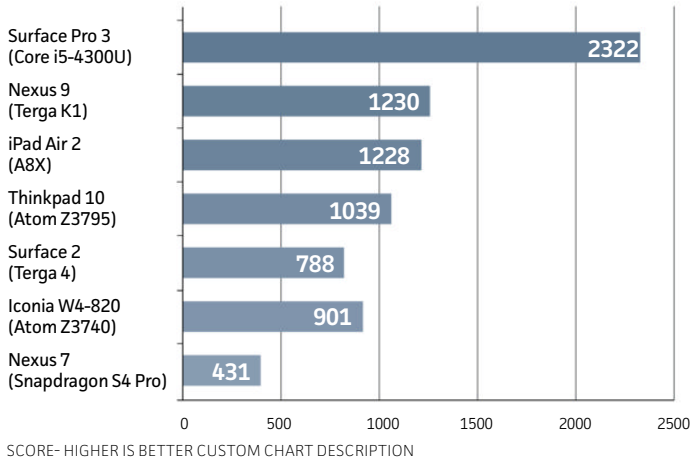
iPad vs. Surface: Fight!

To see how Apple's fastest tablet stacks up against the Surface Pro 3, I dug up performance numbers I've run internally to compare to some publicly available data. In this story I wrote when BAPCo's TabletMark v3 first came out, we can see how the iPad Air 2 and the A8X rate.

Tabletmarket V3 simulates photo editing, web browsing and other typical tablet functions. It's cross-platform and obviously runs on iOS, Android and Windows. Tablemark V3 doesn't leverage Apple's newer Metal API, which is like the company's take on DirectX 12 and OpenCL rolled into one and could show a nice bump in performance.

To be fair to the PC, the Surface Pro 3 is hardly the fastest thing out there. A typical two-year old laptop will be faster. Still, the dual-core

Tabletmark V3 Overall



The Core

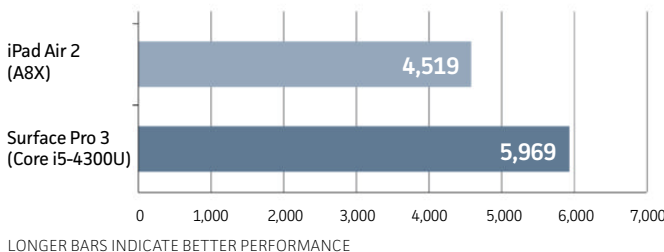
i5-4300U easily thumps all of its ARM competitors, but if the iPad Pro is “1.9X” faster, will it be just as fast?

Core i5-4300U Haswell CPU in the Surface Pro 3 soundly destroys all of the ARM-powered devices.

As another point of reference, I used the results of MacWorld’s review of the iPad Air 2 (go.macworld.com/air2vid) to compare to my own test of a Surface Pro 3 with the Core i5-4300U chip. In these multi-core 32-bit results, the dual-core Haswell again wallops the iPad Air 2, but it’s surprisingly closer than I expected.

Geekbench 3 is a cross-platform test and measures integer, floating

Geekbench 3



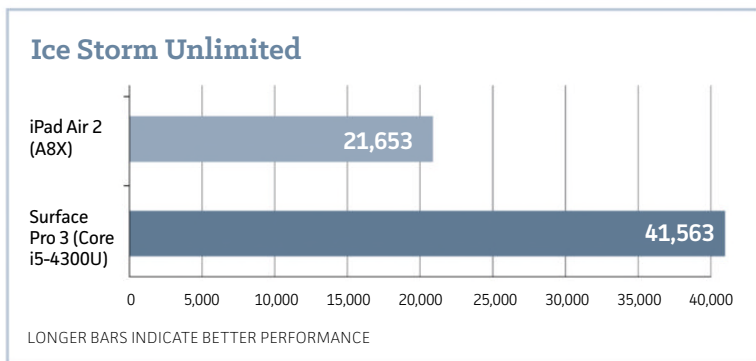
The iPad Air 2

loses to the Surface 3 Pro, but it’s closer than I expected

point and memory bandwidth performance. The developer says the workloads are “real-world” and are similar to what an actual program would stress when decompressing a JPEG file, or running encryption or the like. This isn’t quite the same, as say, running Maxon’s CineBench R15 which uses its own 3D rendering engine as part of its benchmark.

While the iPad Air 2 does quite well for an ARM chip, I’d hazard a guess that if you could run CineBench R15 on the iPad Air 2, it wouldn’t fare as well. Still, people will want to see these Geekbench numbers because they’re readily available on all platforms.

Here’s one last comparison, using 3DMark’s Ice Storm Unlimited gaming test. I made the chart using data from a Surface Pro 3 I tested and public data for the iPad Air 2.



Parsing the data

So does this mean that the iPad Pro’s performance boast of 1.9X over the iPad Air 2 means instant equal footing with a dual-core Haswell or Broadwell chip?

It’s hard to believe, but Schiller could be right from a certain point of view.

I base this on statements the company has made regarding what it thinks the iPad Pro can do. For example, editing three simultaneous streams of 4K video on an iPad Pro is apparently possible now. Schiller

cited this as proof of the iPad Pro’s “desktop-like” performance. That task would indeed be tough on 80 percent of the portable PCs out there, and a good chore for a desktop too.

At the same time, Apple’s demo used iMovie, its in-house video editor, which I’d guess is highly optimized for its hardware. And let’s face it, iMovie is not Adobe Premiere Pro by any stretch of the imagination.

That actually brings up the big disconnect with Apple’s boasts of the iPad Pro’s performance. One task that Schiller said you can’t do is run AutoCAD 360 on a PC with 320,000 objects in a mesh and smoothly pan around. Probably. But after looking at the multiple 1-star reviews of Autodesk’s free mobile AutoCAD 360 app in the Windows Store (Yes, it’s a Metro app), I’d rather just skip it and install AutoCAD 2016.




**The free
Metro-based
AutoCAD360
doesn’t get
highmarks
on the PC.**

iPad Pro can’t do that

And that’s the big difference here. You can install AutoCAD 2016 on a large majority of the “portable PCs” being sold today. And you can also install Photoshop, Premiere Pro and Office.

I’m pretty certain you can’t install the full versions of Photoshop, Premiere, AutoCAD, and Office on the iPad Pro and go to town. That’s because it’s not a PC. It’s not even a Mac. It’s a tablet that runs limited-functionality software really, really well.

Even if the iPad Pro is the fastest tablet when released, and an incredible testament to Apple’s mastery of disciplines in hardware and software, it won’t really be faster than “80 percent of Portable PCs.” That’s because it can’t do things those 80 percent of PCs can do. 



**“ SURE,
AT FIRST I WAS A LITTLE TAKEN ABACK
BY THE WHOLE PEEING STANDING UP THING.
BUT I TAUGHT HIM TO THROW A STICK
AND NOW HANGING OUT WITH HIM
IS THE BEST PART OF MY DAY.”**

**— EINSTEIN
adopted 12-09-10**

**A PERSON
IS THE BEST
THING TO HAPPEN
TO A SHELTER PET**

 **adopt**

theshelterpetproject.org



HERE'S HOW

CONTENTS

120 **How to transform
your laptop into a
gaming power-
house with an
external graphics
card**

135 **How to set up
Mozilla's Firefox
browser the
right way**

139 **How to enter
Windows 10's
Safe Mode**

142 **Hassle-Free PC
How to open files in
Google Drive
directly
from Office**

145 **Answer Line
3 ways to keep
sensitive files
encrypted on a
flash drive or
external hard drive**

How to transform your laptop into a gaming powerhouse with an external graphics card

With a little bit of research and elbow grease, an external graphics setup can turn your laptop into an awesome gaming machine for a fraction of the price of a whole new gaming PC.

BY IAN PAUL

I HAVEN'T BEEN much of a gamer in recent years, but I've always liked the idea of being one. That feeling intensified when I got my first glimpse of the upcoming *Star Wars Battlefront*. Then when I saw the *Fallout 4* trailer, I knew I had to start gaming again.

But I quickly stumbled across a major problem: The only PC I have is a 2011 ThinkPad X220 with Intel HD 3000 integrated graphics. That just wasn't going to cut it for proper PC gaming.

Sure, I could make it work for titles like *Diablo III* with only small moments of stuttering on my laptop's 12.5-inch, 1366-by-728-resolution display, but forget about more graphics-intensive games on an external 1080p display.

That's when it hit me: "Hey, you can have an external hard drive, why



not an external graphics card? Surely somebody's done that."

Many people have. There are even a few companies building their own external graphics card (eGPU) enclosures such as Alienware, MSI, and ViDock. But these eGPU kits tend to be overpriced or use proprietary connection technology.

That's why the bulk of the eGPU gaming world is all about DIY setups.

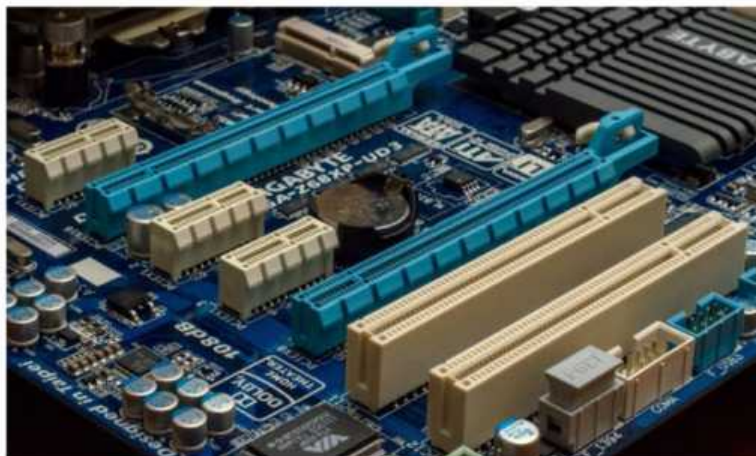
The good news is that many people who go the DIY route end up with a plug-and-play experience requiring little to no modification—but to get to the plug-and-play part, you've got to do your research.

When that's done, however, you'll be left with a killer console-toppling PC gaming setup—all for a cheaper price than a new Xbox One, depending on which graphics card you choose.

The eGPU glossary

Before we get started, I want to introduce a few terms. Without a basic vocabulary the world of eGPU can get confusing, fast. There's not much to see here for veteran gamers—you can skip to the next section.

PCIe x16: PCI Express (PCIe) is the motherboard slot that a standard graphics card fits into. The x16 part means the PCIe slot has 16 lanes



PCIe slots in
a standard PC
motherboard.

that data can travel through. With an eGPU setup we typically compress an x16 slot down to an x1 (1 lane) or x2 (2 lanes) connection to the laptop. That sounds like a raw deal, but it works surprisingly well. PCIe slots come in three generations: 1.0, 2.0, and 3.0. PCIe 4.0 is also in the works but isn't expected until 2017. Most new graphics cards will run on PCIe 3.0, which is backward-compatible with version 2.0.



A 24-pin
power
connector.

PCIe power connector: PCIe can also refer to a type of power connector with six or eight pins.

ATX 24-pin connector: This is another kind of power connector that is commonly used with PC power supplies, and is one of the power options on PCIe adapters.

PCIe adapter/board: This is a small circuit board with a PCIe slot, some HDMI slots, and a whole bunch of power options. The only point of the PCIe adapter is to help the graphics card communicate with the laptop.

Express Card Slot: This is the spot in your laptop that is reserved for wireless broadband cards from a mobile carrier.

mPCIe: This is an interface that some eGPU enthusiasts use to connect their graphics card to their laptop instead of an ExpressCard. It offers a better connection, but it can be a hassle because most mPCIe slots are inside the laptop.

Thunderbolt: Intel's blazing fast I/O technology is also an option for



an eGPU connection. Windows laptops don't commonly offer Thunderbolt ports (yet), but many MacBook eGPU enthusiasts report a great experience with a Thunderbolt connection.

BIOS: This is the program that first starts when you boot your computer. It's usually accessed by hitting F2, another F key, or a special button on your laptop. The BIOS controls a variety of options for your PC including, for example, the boot order.

Frames per second (fps): This is a basic measure of how well a game runs on a given system. The gold standard for PC gamers is 60 fps, though 30 fps is considered perfectly playable. Many "next-generation" console games still run at 30 fps.

eGPU Basic components

A typical eGPU setup requires five basic items: a laptop, a desktop graphics card, an external display, a PCIe adapter/board to house the card, and a separate power supply for the graphics card. You may also want a laptop cooling pad if you are going to try to play games that go heavy on graphics, like *Witcher 3*.

Ideally, your laptop is packing an Intel quad-core Core processor, or a dual-core Core processor with Hyperthreading. It'd also be a great idea to swap your spinning hard drive for an SSD. The latter is far more responsive and makes the gaming experience much better, but it's not a necessity.

The PCIe board is a specialized piece of equipment. The most

popular place to grab a board for ExpressCard and mPCIe users is BPlus in Taiwan (HWTools.net). If you're looking at using Thunderbolt 2.0 for an eGPU setup there are enclosures you can buy. Check out this eGPU setup featured on AnandTech (go.pcworld.com/anandtechgpu), as well as Norway-based blogger Poul Peter Serek's DIY eGPU project (go.pcworld.com/diyegpu) for more details.

Most ExpressCard and mPCIe users will want to get the PE4C 3.0 from BPlus, which has a PCIe-3.0 x16 slot, plus a nice stand to support your card. The PCIe board comes as a kit with power connectors, and an HDMI-to-ExpressCard cable that allows the graphics card to interface with your laptop.

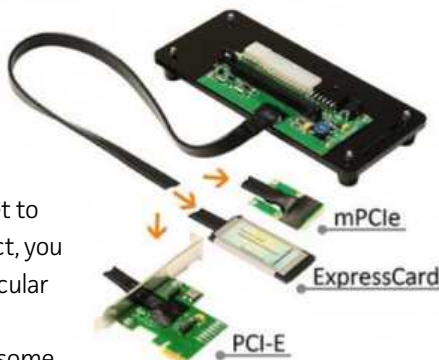
First things first

Not all eGPU experiences are created equal, but they all have one thing in common: You have to do a bit of research before you get to the plug-and-play part. In fact, you may discover that your particular laptop is not plug-and-play-ready whatsoever, requiring some software tweaks to function properly.

The first thing you should do is read about the experiences other eGPU users have had with your laptop model. There are a ton of eGPU users out there, and unless your model is particularly new or obscure, chances are high that someone has already created an eGPU setup with your laptop model.

If you don't find anyone with your model, go back a generation, or search for laptops from the same manufacturer to get a sense of the difficulties.

Two sites are central to eGPU research. The first is the TechInferno eGPU threads (go.pcworld.com/techinfernoegpu) run by Australia-



A BPlus PCIe
board for
external
graphics card
usage.

based Nando4 (we'll just call him Nando) and others. The second is NotebookReview (go.pcworld.com/notebookegpu).

One of the most common roadblocks people run across is what's known as "error 12." This happens when your Windows system decides it does not have enough resources to run the graphics card. Error 12 can usually be fixed with solutions such as Setup 1.30 (go.pcworld.com/setup1.30), a paid software utility by Nando.

For more references also check out YouTube, which is full of people running benchmarks or shooting video of their eGPU setups.

Choosing your graphics card

Once you've figured out what kind of eGPU experience you're likely to have, it's time to start shopping for a graphics card. You can buy pretty much anything, but I wouldn't advise going for a top-of-the-line card such as the Radeon R9 Fury X or the Nvidia GeForce GTX Titan X. Instead, I'd advise you to keep your graphics card budget around \$200 to \$300, or less.

The fact is you can get a really great "sweet spot" card for under

Before I bought eGPU

supplies for my 2011 Lenovo Thinkpad X220, I had to research exactly what I'd need.





The AMD Radeon R9 380—like this superb version by Visiontek—is the best \$200 graphics card you can buy.

\$300 that should provide you at least a few years of future-proofing, such as the \$200 GTX 960 or Radeon R9 380—both are great cards for 1080p gaming. As Nando over at TechInferno told me (via email), you'll likely see better performance with a higher-grade card, but it will still be bottlenecked by that PCIe x1 or x2 connection to your laptop.

More importantly, however, there's no guarantee that an eGPU will work until you try it. If you've done the proper research for your laptop beforehand, the chances of a bad experience are fairly low. Nevertheless, there are always outliers and you just might be the one person who runs into difficulties.

If, however, you plan on buying a new desktop sometime soon, then investing in a high-end card right now can be a way to spread out the cost of a new PC over time.

The other decision is whether to go with an AMD or Nvidia card. Most eGPU users tend to go with Nvidia, so that's what I did.

One thing to keep in mind is that your graphics card typically needs its own power connector to work in an eGPU setup. That could be a problem for cards with minimal power requirements like the GeForce GTX 750 Ti, which draws its power from the motherboard. I didn't test whether the stock GTX 750 Ti would work with a BPlus board, but I did



Corsair's
CX430M PSU.

end up buying an overclocked version of the GTX 750 Ti that comes with a 6-pin PCIe power connector.

Picking your power supply

Along with your graphics card, you'll also need a power supply unit (PSU). There are many reputable brands of PSUs out there, including Cooler Master, Corsair, and Seasonic.

Alternatively, you may only need a power brick similar to what powers your laptop. Take Nvidia's GTX 650 Ti graphics card, which requires 110 watts of power, according to Nvidia's specs. Nando advises that your PSU needs about 15 percent more power than the card (not the system) requires, meaning a 110 Watt card needs a PSU with a minimum of 127 Watts.

BPlus recommends that anyone with a graphics card requiring more than 220W should use the ATX power option with a standard PC PSU.

Personally, I just went with a modular Corsair power supply since a standard PSU is so easy to find. *PCWorld's* guide to picking a PC power supply (go.pcworld.com/pcpowersupply) can help you make smart buying decisions.

Setting it up

The research is done, the BPlus board has arrived, your graphics card is ready for unboxing, and so is the PSU. It's time to get this eGPU rocking.

For our example, we're hooking up an Asus GeForce 750 Ti overclocked edition and a Corsair 430M PSU to a PE4C 2.1a from BPlus. The board connects to a Lenovo X220 via an ExpressCard slot, and the card also connects to an external 22-inch 1080p display via one of the 750 Ti's DVI ports.



First, slip your graphics card into the PCIe slot on the BPlus board.



Next, hook your (not yet powered-on) PSU's 24-pin ATX power supply pins into the BPlus board.



Now connect the 8-pin PCIe connector on the board to the 6-pin power connector on the graphics card.

The final result.

Finally, insert the ExpressCard cable into the laptop, then slide the opposite side of the cable—the one with the HDMI connection—into the HDMI port labeled **X1** on the PCIe adapter. At this point you'd also connect your graphics card directly to your external monitor, typically via HDMI or DVI.

Now it's time for the moment of truth. Flip on your PSU (don't worry if nothing happens yet), power on the external display, and then boot your laptop—or at least, that's the boot order that works for me. Some users report that booting an eGPU setup works only when they hook into the ExpressCard slot after the initial boot, or when Windows has loaded.

Whatever your boot order is, and assuming you had a plug-and-play setup like I did, you should boot into Windows as usual. Your laptop may make a few false starts before it powers on correctly, because you've added new hardware to it. Once you're in Windows, you can check to see if your graphics card is detected by opening the device manager and looking under Display Adapters.

If your graphics card is unidentified, manually download and install your card's drivers from AMD or Nvidia. You may then need to reboot the system to get your eGPU setup working properly.

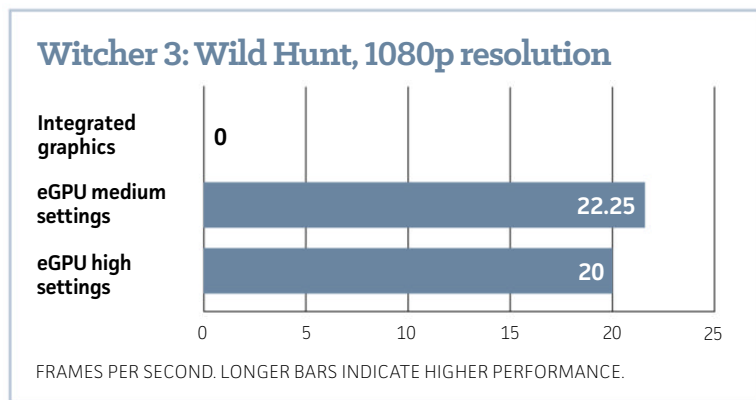
Once that's done, it's on to the wonderful world of gaming. Here's a look at some eGPU benchmarks I ran on my own GTX 750 Ti-powered setup to give you a sense of what to expect from a comparable system. Remember that the GTX 750 Ti is an entry-level graphics card, too. More expensive options, including the \$150 GeForce GTX 950, can obviously perform much better.

Benchmarks

Our test rig in this case is the aforementioned Lenovo ThinkPad X220, packing a 2.7GHz dual-core Intel Sandy Bridge Core i7 2620-M with HyperThreading, 8GB of RAM, a 500GB Samsung 850 EVO SSD, an external 22-inch 1080p display from LG, and Windows 10 Pro 64-bit.

The eGPU is an Asus GeForce GTX 750 Ti OC (2GB DDR5), a Corsair CX430M PSU, and a BPlus PE4c 2.1a PCIe adapter over HDMI to ExpressCard. This adapter is no longer available on the HWTools website (though this close relation is: go.pcworld.com/bplusadapter). Total cost at the time of writing: About \$215 after rebates. That's far less than a whole new gaming PC would cost.

These tests are not meant to be representative of the 750 Ti's performance, but of what an average eGPU setup can expect with similar hardware—and to drive home that even an entry level graphics card can offer a huge leap in gaming performance over CPU-integrated graphics. My tests used a PCIe 3.0 graphics card over a PCIe



2.0 connection. Results would likely be higher with the BPlus PE4C 3.0 not only because of the newer PCIe slot, but also because the HDMI-ExpressCard cable that comes with that kit supplies a better signal to the laptop.

That's enough setting of the scene, though. Let's dig in.

After looking at my numbers for *Witcher 3: The Wild Hunt* most hard-core gamers will likely cringe in horror. I had to dial it down to medium graphics at 720p resolution to get to a consistent 30 fps or more and hit console-level quality—and that was with Nvidia Hairworks (go.pcworld.com/nvidiahairworks) turned off. *Witcher 3* is very graphics intensive, but I noticed serious stuttering and other problems only when the frame rate went below 22 fps.

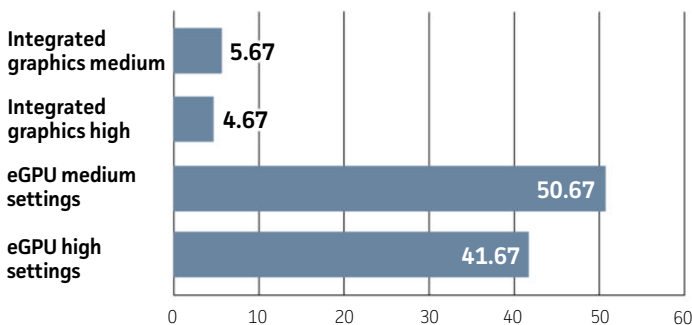
Again, the fact that I can play the game at all, and in full-screen, is a huge step forward over integrated graphics—which couldn't run *Witcher 3* whatsoever. A more powerful graphics card would offer higher frame rates.

That *Witcher 3* works with my rig is also a promising sign for the release of *Star Wars Battlefront* and *Fallout 4*.

I am a little nervous about performance with *Battlefront*, however,

Tip: Buy your games from online retailers with return policies like GOG and Steam, or that offer limited-time trials like EA's Origin. You don't want to be stuck paying \$60 for a game that won't work on your system.

Metro: Last Light Redux, 1080p resolution



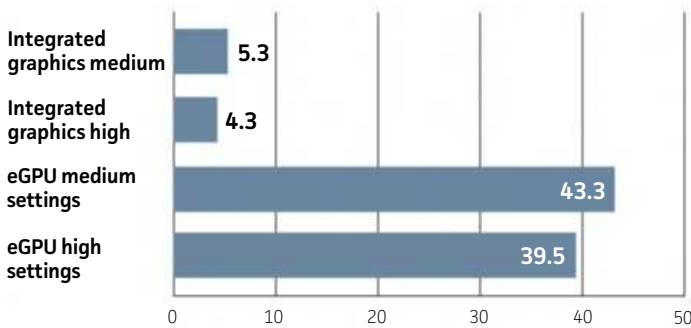
FRAMES PER SECOND. LONGER BARS INDICATE HIGHER PERFORMANCE.



considering it's powered by Electronic Arts' Frostbite 3 gaming engine. I've already tried Battlefield 4—another game based on Frostbite 3—and the game ran for only 10 minutes before it failed.

Less intensive games easily clear the 30 fps mark, however, including Metro: Last Light Redux, which I've benchmarked. To put the integrated graphics performance in proper perspective, however, I've also included some screenshots of the benchmark running with the eGPU disconnected. All those backpacks floating in midair are supposed to be attached to soldiers, but the integrated graphics simply can't handle them.

Unigine Heaven 4.0, 1080p resolution



FRAMES PER SECOND. LONGER BARS INDICATE HIGHER PERFORMANCE.

Finally, check out the major frame rate leap that my eGPU brings in the Unigine Heaven 4.0 benchmark.

The future

The fact that you can go from a laptop that barely runs a 1080p movie without stuttering to a rig that plays Witcher 3 is downright amazing. The future, however, is looking even better for one big reason: Thunderbolt 3 (go.pcworld.com/tb3usb).

Intel specifically called out eGPU scenarios as a use case for Thunderbolt 3 in a blog post (go.pcworld.com/tb3egpu) in June. Thunderbolt 3 promises up to 40 gigabit-per-second theoretical speeds, and eGPU enthusiasts like Nando expect it to offer near-



Thunderbolt 3 will be lightning-quick and compatible with USB Type C ports.


desktop performance for eGPU laptops.

Intel wouldn't go quite that far, but the company is confident that Thunderbolt 3 eGPU setups will offer a better experience than we have now.

"Generally, we expect to see some reduction in performance of a desktop graphics card over Thunderbolt vs. the same card in a desktop PC graphics card slot, because of the lower PCIe bandwidth over Thunderbolt," an Intel spokesperson told us. "But it will still have very good performance, especially compared to the system without the desktop graphics card connected."

Acer, Dell, Asus, and Lenovo have already announced Thunderbolt 3-enabled laptops (go.pcworld.com/tb3laptops) that we'll hopefully see before 2015 is out.

Intel is also working on improving graphics solutions for Windows 10. "We are working with graphics vendors on Windows 10 solutions that will support hot plug/unplug [add or remove graphics without a reboot], an important user experience required for Thunderbolt devices," an Intel spokesperson said. The company expects initial support from AMD.

If you're in the market for a laptop and thinking about eGPU, you'll definitely want to hold off until we see Windows notebooks packing Thunderbolt 3. But if you're looking to add some pep to the step of a laptop you already own, an eGPU connection over ExpressCard or mPCIe is a great way to beef up your hardware without paying for a whole new gaming rig. 

Acer, Dell, Asus, and Lenovo have already announced Thunderbolt 3-enabled laptops that we'll hopefully see before 2015 is out.



How to set up Mozilla's Firefox browser the right way

BY IAN PAUL

MOZILLA FIREFOX IS a great choice for your default browser no matter what operating system you're running, but it's especially handy if you're running Windows 10 since it takes control of Cortana's Bing addiction with no effort on your part. Beyond that, the browser's doing a lot of interesting pro-user privacy things these days, such as instituting a truly private Private Browsing mode (go.pcworld.com/ffprivatebrowsing) that blocks tracking ads, and rolling out ads that actually respect user preferences (go.pcworld.com/ffadprefs).

Firefox also offers many of the advantages that Chrome does, including cloud-based capabilities that sync your bookmarks, browsing history, and

open tabs across devices.

Here's how to set up Firefox the right way so you can get the most of this fantastic open-source browser. This tutorial is based on version 41.0.1.

Firefox Sync

Sync is Mozilla's answer to Chrome's cross-platform service that lets you sync your bookmarks, browsing history, installed add-ons, and open tabs across your PCs and other devices.

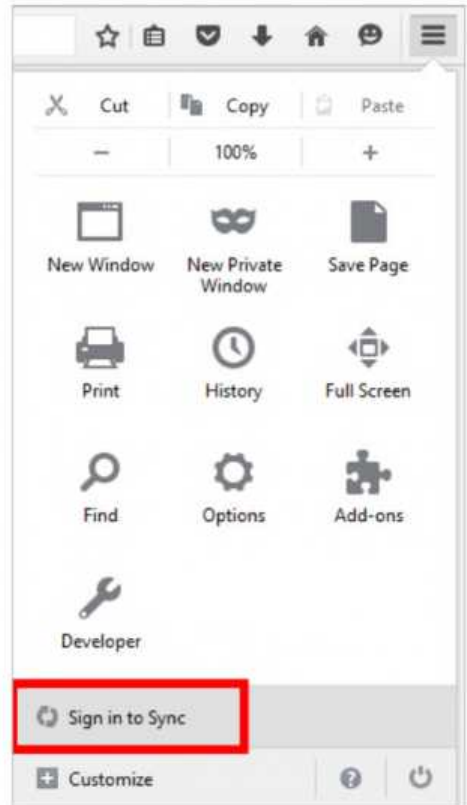
To use Sync you need to sign-up for a Firefox account, which you can do right from your browser.

Click on the "hamburger" menu icon in the upper right corner and select Sign In To Sync, toward the bottom. This will open a tab where you can create a Firefox account. Fill it out as you would anything else, and then click Sign Up.

Mozilla will then send you a verification email that you'll need to click before you can continue. Once that's done, Firefox will start syncing your data to Mozilla's servers so you can access it with Firefox on other PCs, and with Firefox for Android.

By default, Sync saves your tabs, bookmarks, passwords, history, installed add-ons, and preferences. If you'd like to change any of that, open a new tab in Firefox and type **about:preferences#sync**. Then uncheck any boxes under Sync that you don't want saved. Personally, I don't bother syncing passwords since I use a password manager.

To turn off Firefox's feature for saving passwords, type in **about:preferences#security** in a new tab, and then under Passwords uncheck Remember Passwords For Sites.



Get started
with Firefox
Sync right from
the browser's
menu.

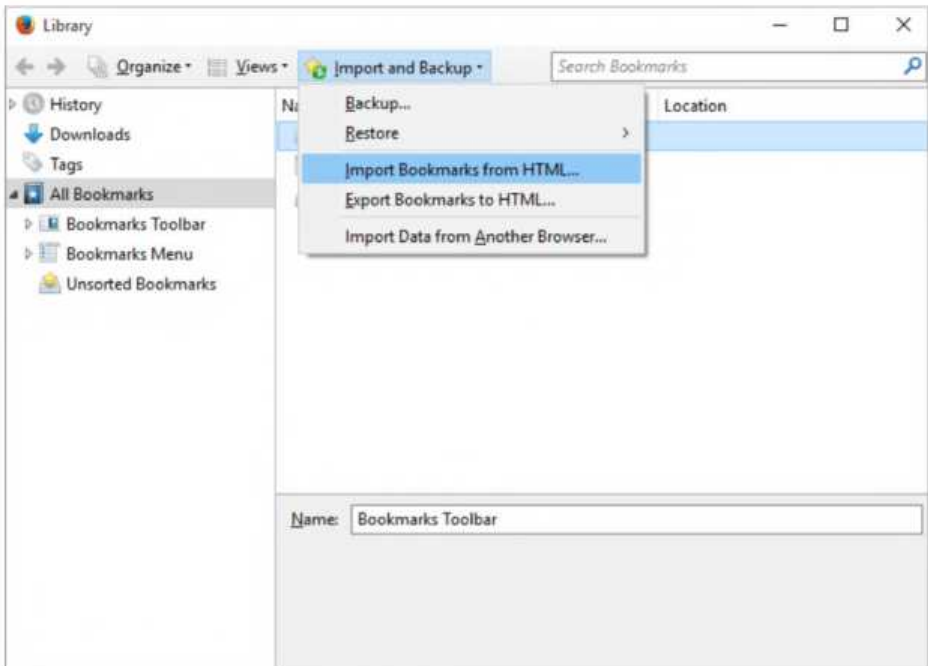
Import bookmarks

When you first install Firefox, you're given the option to then install bookmarks from other browsers installed on your system. If you missed that boat, you can still do it after the initial setup process. First, check out instructions online for how to export bookmarks from Chrome, Internet Explorer, Opera, and Safari.

If given the choice, export your bookmarks as an HTML file and save it somewhere on your PC that you'll be able to find again, such as the desktop or your documents folder.

Now open Firefox and type **Ctrl + Shift + B** to open the Bookmarks Manager. A new window will open; at the top, click the **Import and Backup** button and select **Import Bookmarks from HTML**. Select the HTML file you exported from your old browser in the previous step, and Firefox will do the rest.

You can import your bookmarks from other browsers via Firefox's bookmarks manager.



Must have add-ons

Like Chrome, Firefox has a healthy add-ons catalog to enhance the capabilities of your browser. To start installing add-ons, type **about:addons** into a new tab and hit *Enter*.

Privacy and security conscious users will want to use NoScript (go.pcworld.com/ffnoscript), a classic Firefox add-on from developer Giorgio Maone that stops JavaScript and other content from running without your say-so. It has granular permissions that give you control over exactly what runs and what does not on every site you visit.

Another privacy favorite is the Electronic Frontier Foundation's HTTPS Everywhere (go.pcworld.com/httpseverywhere). This add-on forces most popular sites to connect to you over a more secure HTTPS connection if an HTTPS connection is available for the site. This makes it much harder for anyone to snoop on your online activity. You may not think reading the news or your favorite blog is important enough to keep private, but that kind of activity can betray your political leanings, interests, and religious views (or lack thereof) to name just a few data points you may want to keep private.

Another great tool is Download Manager Tweak (go.pcworld.com/ffdltwak), an add-on that adds some power to Firefox's download manager. You can open the manager in a tab or sidebar, delete a downloaded file, and re-download files.

Firefox also comes with the add-on from read-it-later service Pocket (go.pcworld.com/ffpocket) built-in.

If you want to take a look at more Firefox add-ons, check out our look at 25 browser add-ons (go.pcworld.com/ffadons) that make your life easier. 🔌

Firefox also comes with the add-on from read-it-later service Pocket built-in.

Startup Settings

Press a number to choose from the options below:

Use number keys or functions keys F1-F9.

- 1) Enable debugging
- 2) Enable boot logging
- 3) Enable low-resolution video
- 4) Enable Safe Mode
- 5) Enable Safe Mode with Networking
- 6) Enable Safe Mode with Command Prompt
- 7) Disable driver signature enforcement
- 8) Disable early launch anti-malware protection
- 9) Disable automatic restart after failure

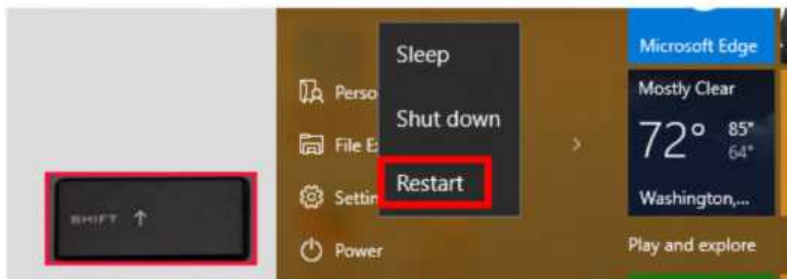
How to enter Windows 10's Safe Mode

BY LINCOLN SPECTOR

WINDOWS' SAFE MODE provides a simple, stripped-down version of the operating system. The programs that usually load automatically when you boot Windows don't do that here. And Safe Mode only uses the most generic drivers. Thus, Safe Mode can be a big help for diagnosing certain problems. For instance, it's a great place to scan for malware.

But the old-fashioned way to get into Safe Mode—booting the PC and pressing F8 at the exact right moment—seldom works on PCs running Windows 10. These techniques will:

If you can successfully boot into Windows, booting into Safe Mode is relatively easy—if you know the trick.



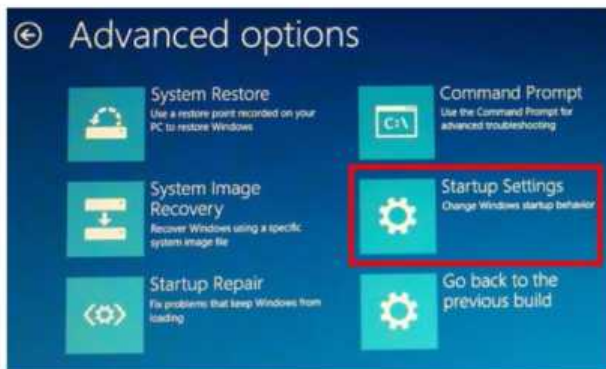
1. Click or tap the Start button, and then the Power button. Hold down the Shift key when you select Restart.
2. In the resulting, full-screen menu, select Troubleshoot → Advanced Options → Startup Settings.
3. In the Startup Settings screen, tap the Restart button.

The PC will reboot, and bring you to a Startup Settings screen.

4. Use the arrow keys on your keyboard to select Enable Safe Mode or Enable Safe Mode With Networking.

But what if things are so bad that you can't successfully boot the operating system?

Try booting anyway. If you can get to the login screen, you'll find a power icon in the lower right corner. The instructions above work there.



But what if you can't get to the login screen? In that case, chances are that Windows is so messed up that it couldn't boot into Safe Mode anyway. But here's a trick that *might* work:


You'll need the Windows 10 Recovery Drive, which you should make now, while your PC is still healthy. You'll need a flash drive that you will use only for this purpose. Any files already on that drive will be

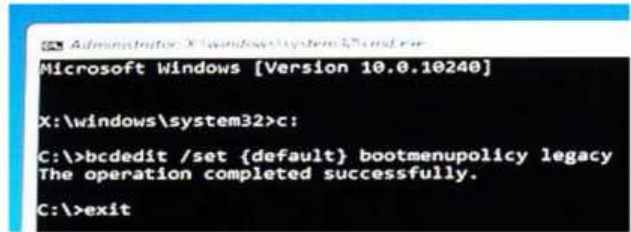
deleted. To create the Recovery Drive, plug in the flash drive, open Control Panel's Recovery tool, click Create A Recovery Drive, and follow the prompts.

You might want to test this before you're in a difficult situation: Boot the Recovery Drive and select your keyboard layout. Then select Troubleshoot → Advanced Options → Command Prompt.

At the command prompt, enter these three lines, making sure to hit Enter at the end of each one:

- **c:**
- **bcdedit /set {default} bootmenupolicy legacy**
- **exit**

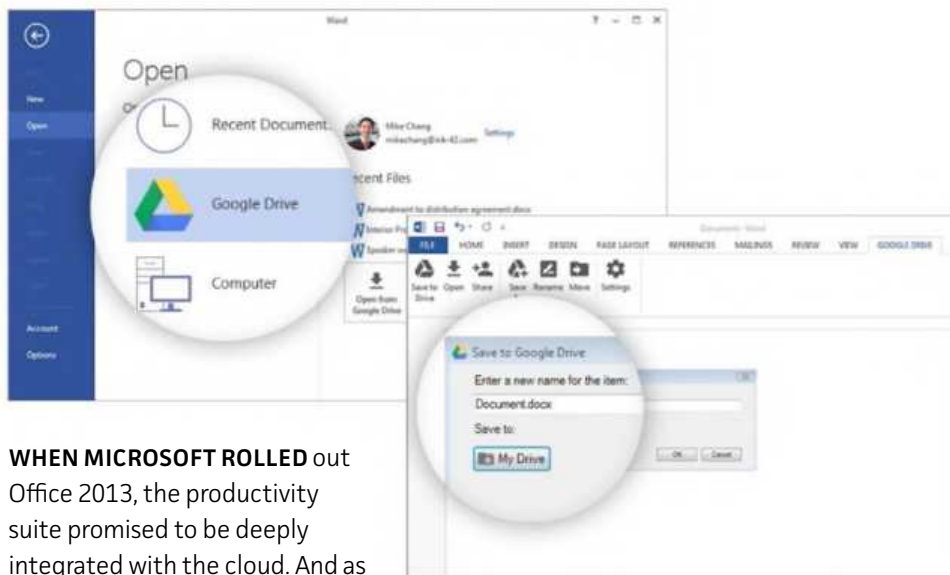
Select Turn Off Your PC. Boot the computer and repeatedly press and release F8 until the Advanced Boot Options menu pops up. Then you can select Safe Mode or Safe Mode With Networking. 



```
Administrator: X:\windows\system32\cmd.exe
Microsoft Windows [Version 10.0.10240]
X:\windows\system32>c:
C:\>bcdedit /set {default} bootmenupolicy legacy
The operation completed successfully.
C:\>exit
```



How to open files in Google Drive directly from Office



WHEN MICROSOFT ROLLED out

Office 2013, the productivity suite promised to be deeply integrated with the cloud. And as long as you were invested in

Microsoft services such as OneDrive, it was. But other services you may use to stash your documents in the cloud, such as Dropbox and Google Drive? Well, not so integrated.

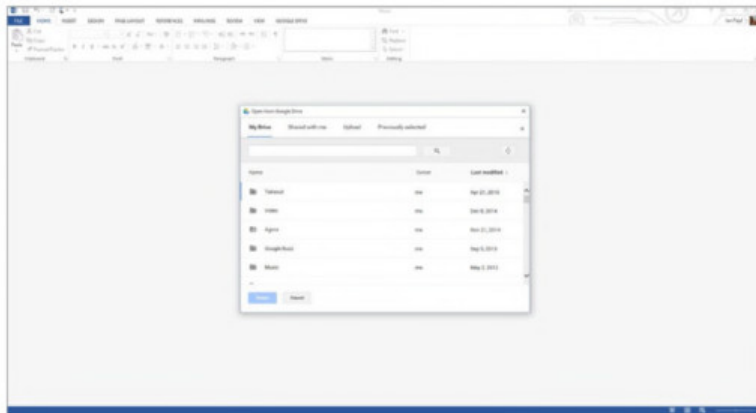
Google aimed to improve the situation in July, when it rolled out its own plug-in for Office (go.pcworld.com/googledriveoffice) that works with every version of the suite released since Office 2007—including the Office 2016. The new plug-in lets you open items stored in Google Drive directly in Office, similarly to how Office's OneDrive integration works.

Here's how Google's plug-in works in Office 2013.

than in your browser. But only if it's in an Office file format rather than Google's proprietary Docs format.

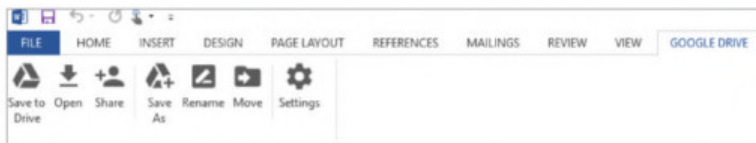
Google Drive's Ribbon addition

A handy tweak is to click on Google Drive → Settings and in the pop-up window that opens, select Microsoft Office Files Only in the drop-down menu. There's no sense in seeing documents in the Google Drive format since you can't open them with Office. When you're done click Close. Changing this setting in one Office program will change it in all of them.




Grabbing files from Drive isn't as integrated as with OneDrive, but it works.

The Google Drive plug-in also adds a new tab in the Office Ribbon with some basic Google Drive-related features, such as Save To Drive, Open (a Drive document), Share, Save As, Rename, Move, and Settings.



Google Drive's Ribbon addition.

Dropbox has yet to offer a similar tool for Office for the desktop. However, How To Geek recently published a tutorial—that involves using a third-party script—on how to add Dropbox to Office (go.pcworld.com/dropboxtooffice). 



3 ways to keep sensitive files encrypted on a flash drive or external hard drive

Files you carry in your pocket can be easily lost or stolen. You can thwart the thieves with these easy techniques.

NarsiReddy Cheruku wants a way to encrypt files that are stored on a flash drive or external hard drive.

Flash drives are easy to lose. And anything lost can fall into the wrong hands. So if you're carrying around sensitive information in your pocket, you need to make sure those files are encrypted.

Here are three possible solutions:

Buy an encrypted drive

You can buy a flash drive with built-in encryption, such as the DataTraveler Locker+ G3 (go.pcworld.com/dtlpg3). When you plug the Locker+ in, it comes up as a 13MB, read-only drive. But once you launch the program file on that drive and enter the password that you previously setup, another drive opens up with all the storage space you paid for. That drive, of course, is inaccessible without the password. The software runs off the drive, and it can be used on multiple computers and operating systems.



But I strongly recommend against using this drive's optional cloud backup feature. It uses Dropbox, OneDrive, or whichever cloud service you pick, which at first glance seems like a nice convenience. But this feature uploads the files without its own encryption. That means you're trusting your sensitive files to the encryption capabilities of Dropbox and similar services, and they aren't all that secure. Find another way to backup these files—preferably one where you can control the encryption.



The DataTraveler Locker+ G3 starts at about \$15 for the 8GB drive, and we've looked at other encrypted USB drives (go.pcworld.com/encryptedusbdrives) as well.

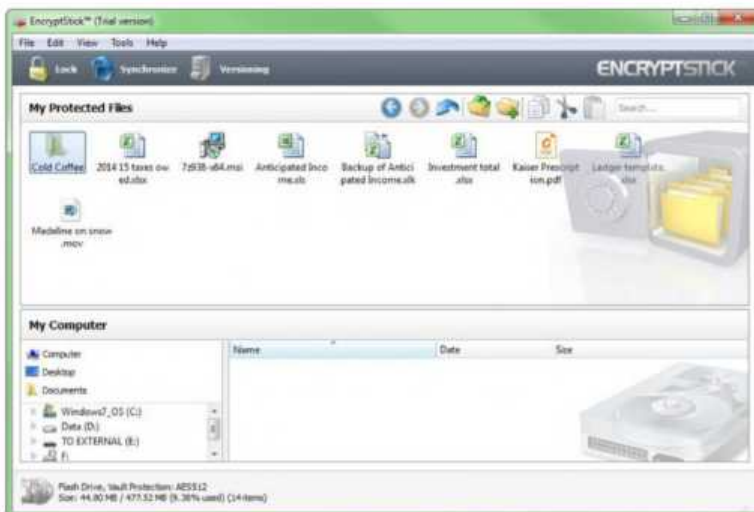
Install specialized software on your drive

If you already have a drive you want to use, consider installing ENC Security Systems' EncryptStick (encryptstick.com). You have to install EncryptStick onto your main PC, but it runs as a portable program on any other computer.

EncryptStick won't let you access your encrypted files directly from Windows/File Explorer here. You have to use the program to access your files. From there, you can drag and drop files in and out of the container, open files into their respective programs, edit, and delete them.

One nice touch: The encrypted files take up only the space they need. You can use the rest of the drive for files that don't need protection.

After a two-week trial period, EncryptStick costs \$14.



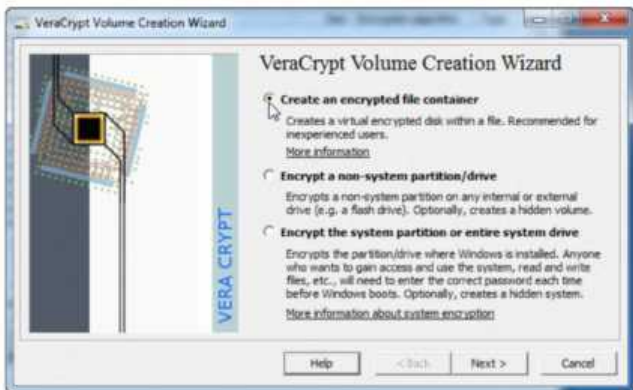
Use free software that's not really all that portable

Regular readers know I'm a fan of VeraCrypt (veracrypt.codeplex.com), a free, open-source encryption tool. There are several ways to use VeraCrypt, but I recommend creating an encrypted container (also called a volume or a vault).

You can install VeraCrypt as a portable program. Plug in your external drive, and launch the downloaded installation program. On the page immediately after the EULA, select **Extract**.

This will put a portable version of VeraCrypt onto your external drive. You can create a vault, of any size, on the external drive.

But there's a problem. The portable version of VeraCrypt works only if you're using an administrator-level account or have the password for one. Or, of course, if the non-portable version is installed on the machine. This seriously limits with which computers you use the program. 🛑



Have a tech question? Ask PCWorld Contributing Editor Lincoln Spector.
Send your query to answer@pcworld.com

Tech Spotlight

A video showcase of
the latest trends



Watch the
video at
go.pcworld.com/ford-edgevid



Ford Edge: Exploring high-tech driving aids in my new robot friend

» Ford's Edge is a robot car that can smooth out some of driving's tougher problems. It can look around corners and blind spots for you. It can keep you in your lane. It can even help you park. But don't surrender entirely to its artificial intelligence. Even a robot still has trouble parking.

PCWorld enhanced editions

Get your digital PCWorld now!

**The best way to experience
PCWorld magazine on your device.**

The enhanced editions on Android, iPad, and Kindle provide these kinds of interactivity and more!



VIDEOS: Tap and play videos
(with Internet connection).



SLIDESHOWS: Swipe
image to activate slides.



360-DEGREE VIEWS:
See products from all angles.

➔ Get it here: go.pcworld.com/digital
DIGITAL SUBSCRIPTIONS: Monthly recurring, \$1.99 per month; single issue, \$6.99